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INDIA ASSOCIATION OF EPIDEMIOLOGISTS

World Health Organization
Regional Office for South-East Asia

South-East Asia Regional Conference on Epidemiology

New Delhi, 8-10 March 2010

The proceedings

In partnership with:

CDC

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THE INCLEN TRUST

ICMR

PUBLIC HEALTH FOUNDATION OF INDIA

IEA
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South-East Asia Regional Conference on Epidemiology

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Preface

In an interdependent world of today, the health determinants such as chronic poverty, financial crisis, climate change and emerging infections are often inter-linked; solving one can help others too. To respond effectively to these problems, epidemiology as a discipline can play a critical role in building an evidence base crucial for programme planning and strategy development, as well as for advocacy.

Epidemiology and its application has evolved from the study of epidemics in the 19th century to studying chronic diseases during the 20th century. In the new millennium, epidemiological thinking and concepts can help respond to the prevailing needs of the countries including emerging conditions and in addressing health inequity and social inequalities prevalent in the society.

It was against this background that the South-East Asia Regional Conference on Epidemiology was organized by WHO and the Indian Association of Epidemiologists, in partnership with the US Centers for Disease Control and Prevention (CDC), the World Bank, International Clinical Epidemiology Network (INCLEN), International Epidemiology Association, Public Health Foundation of India, McGill University, All India Institute of Medical Sciences and the Indian Council of Medical Research. The objectives of the conference were to promote the role of epidemiology in public health action and advocate for its application in national programme development and management.

Over 350 health professionals from the 11 Member States of the WHO South-East Asia Region as well from the other regions participated in the conference.

Largely due to the support from partners and all those involved in its organization, the conference contributed significantly in sharing experiences and discussing the value of evidence-based information to sharpen the focus of health interventions to respond to community needs.

The conference concluded with some specific recommendations for follow-up and issued the Delhi Declaration on Epidemiology calling for a time-bound roadmap to be developed by all Member States. During the months following the conference, eight countries namely Bangladesh, Bhutan, DPR Korea, Indonesia, Maldives, Nepal, Sri Lanka and Timor-Leste organized national meetings on epidemiology and developed roadmaps as articulated in the Delhi Declaration. Clearly, the conference has been instrumental in reinvigorating the process of epidemiological capacity strengthening in the Region. This momentum must be maintained and even accelerated in the coming years.

Dr. Jai P. Narain,
Conference Co-chair and Director,
Communicable Diseases, WHO/SEARO

Foreword

The health systems in several developing countries are facing multiple challenges. These include resource constraints, the effects of globalization, financial crisis, the impact of climate change on health, emergence of new infectious diseases, burgeoning burden of noncommunicable diseases, rapid urbanization and degradation of the environment. Within the health systems, larger allocations are made for patient care vis-à-vis public health action. This has led to a weakening of public health capacity which is so critical for mounting an effective response to address these issues.

The challenges being faced by the health sector warrant strategic thinking, strengthening of the health infrastructure and improving its efficiency. This also demands evidence-based prioritization with the focus on most vulnerable populations to ensure equity and social justice. A basic tool for such decision making is the science of epidemiology that focuses on the distribution and determinants of health in populations, and using such data for action.

To enhance the visibility of epidemiology and dissemination of its importance based upon global experiences, the South-East Asia Regional Conference on Epidemiology was organized by WHO in collaboration with several national and international partners. The Conference provided a platform to bring together various stakeholders and to create valuable learning experiences on several aspects of epidemiology in virtually all areas of health services. The discussions also yielded an invaluable insight into innovative approaches adopted in various settings to solve prevailing and emerging health problems. The deliberations highlighted the value of evidence-based information to sharpen the focus of public health actions to respond to community needs.

I am happy to note that the Conference was extremely successful in achieving its primary objectives - promoting the role of epidemiology for public health action and advocating for its application for national programme development and management. The deliberations at this Conference which are published in these proceedings and the guiding principles articulated in the Delhi Declaration provide a valuable means to use epidemiological principles in the delivery of health interventions with speed, scale and sustainability. This, in turn, can help improve access to and quality of health services as well as facilitate the achievement of the Millennium Development Goals.

Samlee Plianbangchang

Dr Samlee Plianbangchang
Regional Director

Acknowledgements

The South-East Asia Regional Conference on Epidemiology, organized from 8 -10 March 2010 in New Delhi, provided a unique opportunity to some 350 programme managers, policy makers, academicians, and researchers for sharing information and experiences in the use of epidemiological principles for policy-making, programme development and management. All the participants are thanked for their wisdom and interactions, leading to a set of concrete recommendations, especially the Delhi Declaration on Epidemiology which provides a roadmap for strengthening epidemiological thinking in the Region.

The conference truly reflected strong partnership, with all the partners exercising full ownership and contributing together towards a successful outcome. The partners besides the Indian Association of Epidemiologists (IAE) and the World Health Organization Regional Office for South-East Asia (WHO-SEARO), included the US Centers for Disease Control and Prevention (US CDC), the World Bank, International Clinical Epidemiology Network (INCLEN) Trust, All India Institute of Medical Sciences (AIIMS), Indian Council of Medical Research (ICMR), Public Health Foundation of India (PFHI), the International Epidemiological Association (South-East Asia Branch), and McGill University. Sincere thanks are extended to the partners for their invaluable support and contributions in making this conference truly memorable.

The planning and preparation for the conference was spearheaded by the Organizing Committee consisting of various partners who worked diligently to ensure very useful and productive deliberations. It consisted of Dr Shiv Lal (President, IAE), Dr Narendra K Arora (Executive Director, INCLEN), Drs Rubina Imtiaz and Renu B Lal (US CDC), Drs Mariam Claeson and G Ramana (World Bank), Dr CS Pandav (Professor and Head of Centre for Community Medicine, AIIMS), Dr Srinath Reddy (President PHFI), Drs Dipali Mukherji and V Kumaraswami (ICMR), Dr Ronald Waldman (USAID and Mailman School of Public Health, USA), Drs D Bora and Akshay Dhariwal (IAE) and Drs Lalit M Nath, Rajesh Bhatia, AP Dash and Jai P Narain (all from WHO-SEARO).

The Advisory Committee was very ably assisted by the Technical Committee chaired by Dr NK Arora which developed the technical programme and identified speakers and chairs, and by the Logistics Committee composed of Dr AP Dash, Dr D Bora, Dr A Dhariwal, Mrs Asha Kukreja and Mr Gulshan Kumar, working closely with the event management company PLAN IT (Mr Rajiv Pandey, Manager and Mr Hemant, Assistant Manager) who rendered tireless and sustained support to ensure a successful conference.

Participation of great majority of participants from India was supported through World Bank supported Integrated Disease Surveillance Project (IDSP), India.

The organizers thank all the speakers for excellent presentations which formed the backbone of the conference and are reproduced in these proceedings. Without their valuable contributions as well as the stewardship of the Chairs and the incredible support of many WHO staff who performed the role of the Session Coordinators, the conference could not have been so successful. They deserve our deep appreciation and grateful thanks.

The conference deliberations were expertly summarized and presented by two able rapporteurs --- Drs Rajesh Kumar and Rajesh Bhatia. Prof Lalit M Nath did an excellent job of facilitating drafting, consensus building and ultimately adoption of the Delhi Declaration on Epidemiology.

Special thanks to CDC for additional financial support. The facilitatory support rendered by the Public Health Management Institute(PHMI), based in Hyderabad especially by the Executive Director, Dr Ganesh Orunganti, SHARE India and Dr Jammy Guru Rajesh, Associate Project Director at PHMI who also attended the conference are gratefully acknowledged.

The support provided by various units in WHO-SEARO namely ISM (Mr Virender Singh), TPD (Mr Puneet Dhingra and team), and PRN (Mr R.S. Pahwa) was extraordinary.

Taj Palace hotel provided a wonderful and comfortable venue for all guests and participants.

Finally, the proceedings. A number of people assisted in this undertaking, from recording the presentations, typing the transcripts and editing for the required stylistic standards to formatting and printing; all of them are thanked sincerely, especially the speakers for their patience while reviewing the drafts. Although due care has been taken in compiling these, any omissions or lapses which may have occurred are deeply regretted. Grateful thanks are due to Dr Rajesh Kumar for reviewing the transcripts for content and to Mr A S Kochar for language editing, Mrs Asha Kukreja and Ms Rekha Anand for their painstaking secretarial support. It is hoped that the proceedings of the South-East Asia Regional Conference on Epidemiology will facilitate and contribute towards further strengthening of epidemiology in Member States of the Region.

Abbreviations and acronyms

ACT	artemisinin-based combination therapy
ADB	Asian Development Bank
AIDS	acquired immunodeficiency syndrome
AIIMS	All India Institute of Medical Sciences (New Delhi, India)
ART	antiretroviral therapy
ARV	antiretroviral
BMI	body mass index
BRFSS	Behavioural Risk Factor Surveillance System
BTS	Brain-to-Society (approach)
CARMEN	Conjunto de Acciones para Reduccion Multifactorial de Enfermedades Non Transmissible
CBRN	chemical, biological, radiological, nuclear (laboratory)
CDC	Centers for Disease Control and Prevention (Atlanta, USA)
CINDI	Countrywide Integrated Noncommunicable Diseases Intervention
CSDH	Commission on Social Determinants of Health
CVD	cardiovascular disease
DALY	disability-adjusted life year
DF/DHF	dengue fever/dengue haemorrhagic fever
DOTS	directly observed treatment, short
EIS	Epidemic Intelligence Service (USA)
EMAN	Eastern Mediterranean Approach to Noncommunicable Diseases
ENSO	El Nino-Southern Oscillation
ESCAP	Economic and Social Commission for Asia and the Pacific (UN)
EVIPNet	evidence-informed policy network
FCTC	Framework Convention on Tobacco Control
FETP	field epidemiology training programme
GAVI	Global Alliance for Vaccines and Immunization
GDDC	Global Disease Detection Center (CDC, USA)
GDP	gross domestic product
GIS	Geographic Information System
GPS	Geographic Positioning System

GRADE	Grading of Recommendations Assessment, Development and Evaluation
HIV	human immunodeficiency virus
ICESCR	International Covenant on Economic, Social and Cultural Rights
ICMR	Indian Council of Medical Research
IDSP	Integrated Disease Surveillance Programme (India)
IDU	intravenous drug user
IEC	information, education, communication
ILI	influenza-like illness
IMCI	Integrated Management for Childhood Illness
IMR	infant mortality rate
IPCC	Intergovernmental Panel on Climate Change
IR	incidence rate
ISO	International Organisation for Standardisation
IUTLD	International Union against Tuberculosis and Lung Diseases
LMICs	low- and middle-income countries
MCI	Medical Council of India
MCTC	mother-to-child transmission (of HIV/AIDS)
MDG	Millennium Development Goal (UN)
MEGAPHONE®	Montreal Epidemiological and Geographic Analysis of Population Health Outcomes and Neighbourhood Effects
MIFA	Managing Information for Action
MIS	Management Information System
MMR	maternal mortality ratio
MOANA	Mobilization of Allies in Noncommunicable Diseases
MoH&FW	Ministry of Health and Family Welfare (India)
MSM	men who have sex with men
MWP	(McGill) World Platform for Health and Economic Convergence
NACO	National AIDS Control Organisation (India)
NACP	National AIDS Control Programme (India)
NANDI	Network of African Noncommunicable Diseases Interventions
NCD	noncommunicable disease
NCDC	National Centre for Disease Control (India)
NGO	nongovernmental organization
NIE	National Institute of Epidemiology (India)
NIV	National Institute of Virology (India)
NRHM	National Rural Health Mission (India)
ORS	oral rehydration salts/solution
ORT	oral rehydration therapy
PPP	public-private partnership
PPTCT	prevention of parent-to-child transmission (of HIV/AIDS)
RCT	randomized control trial
SARS	severe acute respiratory syndrome
SBP	systolic blood pressure

SEANET-NCD	South-East Asia Network for Noncommunicable diseases Prevention and Control
SEAR	South-East Asia Region (of WHO)
SEARO	South-East Asia Regional Office (of WHO)
SES	socioeconomic status
SOP	standard operating procedure
SRRT	surveillance and rapid response team
TB	tuberculosis
TEPHINET	Training Programme in Epidemiology and Public Health Intervention Network
TI	targeted intervention
UDHR	Universal Declaration of Human Rights
U5MR	under-five mortality rate
UNAIDS	Joint United Nations Programme on HIV/AIDS
USAID	United States Agency for International Development
WHO	World Health Organization
WPR	Western Pacific Region (of WHO)
WPRO	Western Pacific Regional Office (of WHO)

Section 1

Opening ceremony

Executive summary and conference recommendations

Delhi Declaration on Epidemiology

Welcome address

Dr Shiv Lal
Conference Chair and President of Indian Association of Epidemiologists

On behalf of Organizing Committee of the South-East Asia Regional Conference on Epidemiology, which is being organized for the first time, I extend my warm welcome to Shri Kapil Sibal ji, the Honorable Minister for Human Resource Development, Government of India. Hon. Minister of Health and Family Welfare, Government of India, Shri Ghulam Nabi Azad had kindly agreed to grace this occasion in spite of his busy schedule, but due to his other sudden urgent commitment, he has not been able to be with us today. However, he has sent good wishes for the conference. We are grateful to him. Epidemiology basically deals with the analysis of the situation in terms of where, when, who, and how much the problem is? It is applicable across wide spectrum of activities including social sector. We are keenly looking forward to explore the possibility for its inclusion in various courses like social and behavioral, ecological and geographical epidemiology.

Dr. Samlee Plianbangchang, Regional Director, WHO/SEARO, a leading public health professional, who has regionally and globally pioneered many initiatives in the field of public health has been the inspiration and a source of constant support for organization of this conference. We very warmly acknowledge his guidance, and I welcome him to this conference.

For making arrangement of the conference both technically and logistically, in which approximately 350 delegates from the Region and outside the region are participating, a lot of planning and hard work has gone in to it. Co-chair of the organizing committee Dr. Jai P. Narain shouldered all these responsibilities. We thank him for his persistent efforts.

We welcome the dignitaries and distinguished delegates of the co-sponsors of this conference namely, CDC Atlanta, World Bank, INCLEN, PHFI, AIIMS, ICMR, McGill University, the International Association of Epidemiologists, who have immensely contributed for organizing this conference. Success of any conference is largely determined by the quality of deliberations. You would appreciate that this conference has been able to bring together a galaxy of eminent international and national experts in the field of epidemiology and public health. As speakers, chairpersons and delegates, we very warmly welcome each one very gratefully, thank their sponsoring authorities for sparing their time for this conference.

We also welcome amongst us the print and visual media. I hope coverage of this event will further enhance the practice of of epidemiology in the Region. Lastly, ladies and gentlemen, I take this opportunity of welcoming one and all without being able to name them individually who have graced this occasion.

Conference objectives

Dr Jai P. Narain
Conference Co-chair and Director, Communicable Diseases, WHO/SEARO

Honorable Minister for Human Resource Development, Government of India, Mr. Kapil Sibal, Dr. Samlee Plianbangchang, WHO Regional Director for South East Asia, Dr. Shiv Lal, distinguished delegates, colleagues, friends, and ladies and gentlemen, very warm welcome to Delhi.

I am truly delighted at the level of interest and enthusiasm for this conference. I thank all of you for taking time to participate in the deliberation of Regional Conference on Epidemiology organized jointly by Indian Association of Epidemiologists and WHO Regional Office for South East Asia in partnership with World Bank, Center for Disease Control and Prevention, USA, International Clinical Epidemiology Network, International Epidemiology Association, Indian Council of Medical Research, All India Institute of Medical Sciences, Public Health Foundation of India, and McGill University of Canada. Today is indeed a historic day. We all meet together to discuss the principles and practice of epidemiology, which basically deals with the distribution and determinants of disease and illness in human populations and which helps in providing evidence based information for public health action. More specifically, epidemiological data or evidence can help us in setting priorities, in an environment of limited resources, in planning of our strategies and policies, in advocating for timely and coordinated action, and finally in monitoring and evaluating the impact of interventions.

The subject of this conference, is not only of topical interest but is also of fundamental importance. To many of us, epidemiology in fact does mean using analytical approach to decision making and for delivery of health services at every level, be at national level, provincial level, district level or at a community level. In view of this and given that epidemiology is the very foundation of public health, building and strengthening epidemiology capacity is essential at all levels of health services. Keeping this in mind, we have planned this three day conference with the main idea of deliberating how we can better apply epidemiological concepts in national health program development and management, and also to identify next steps needed to ensure that all public health actions in the region are based on evidence. To achieve these objectives of this conference, the plan is to have plenary sessions in the morning and three parallel sessions in the afternoon at least for day 1 and day 2.

The plenary sessions will consist of presentations on topics such as enduring relevance of epidemiology, role of epidemiology in the context of health security, MDGs and on climate change, and share ideas on critical issues such as human resource and capacity building, on research and policy interface. We have also three interesting special lectures – on access and use of data; economic crisis and health of the poor, how evidence can help; and third is, on use of epidemiology in monitoring, evaluating health interventions. The presentations in the afternoon will seek to consider and demonstrate how epidemiological principles can be applied in various programme areas such as control of communicable or non-communicable diseases, maternal and child health as well as public health emergencies such as natural disasters, disease outbreaks or pandemics such as H1N1.

Of the two skill building sessions, one will dwell on research methods and the other on scientific writing. On the last day, we will have a feed back from the rapporteur with summary of conference deliberations including some broad conclusions and a set of recommendations emanating from the conference. The rapporteur session summaries will be presented during the valedictory session. In fact, some delegates have been in touch with organizers pointing out the desirability of having something like Delhi Declaration on Epidemiology. And this too will be presented in the afternoon on the last day.

Dear colleagues, let me conclude by saying that we have, together with our partners, tried to put together what we think is a good conference programme. I would like to seek your forgiveness for any short-comings that you may encounter in next three days. We look forward to an exciting and productive conference.

Opening remarks

Dr Samlee Plianbangchang
WHO Regional Director, South-East Asia

Your Excellency, Shri Kapil Sibal, Honorable Minister for Human Resource Development, Government of India; distinguished participants; honorable guests and partners; ladies and gentlemen:

With great pleasure I welcome you all to the SEA Regional Conference on Epidemiology. The conference is jointly organized by the WHO South-East Asia Regional Office and the Indian Association of Epidemiology. I overwhelmingly thank the Honorable Minister for Human Resource Development for accepting to grace the inauguration of the meeting.

In view of the current worldwide health challenges, the broad topic of the conference is indeed timely. As far as the South-East Asia Region is concerned, the health situation has undergone a remarkable change over the past several decades.

The achievements overall from socioeconomic development and from the improved capacity of health-care systems have significantly contributed to the longevity and quality of life of people in the Region. The availability of vaccines and antimicrobials has helped to effectively reduce the impact of infectious diseases. Access to quality health services at all levels has substantially improved. Many of the erstwhile "epidemic-prone diseases" have been brought under control.

However, there is still a long way to go to attain the goal of quality health care for all people. The ideal of "equity in health" with due regard to social justice is yet to be universally achieved nationally and internationally. The threat from communicable diseases continues, with new virulent strains or agents. The older menace from infectious agents keeps re-emerging. Recent global experience, such as the H1N1 influenza pandemic, has underlined the need for continued vigilance and preparedness.

Furthermore, demographic transition, with increasing longevity has brought about an epidemiological transition in disease patterns. Diseases due to unhealthy lifestyles already contribute to the majority of morbidity and mortality worldwide. In addition, we have the intractable problem of maternal and newborn mortality.

This problem requires urgent action, if we are to achieve Millennium Development Goals 4 and 5 by the target date. In order to ensure an effective response to these very disparate issues, there is a need for a common bond to hold the various diverse elements of health systems together. This challenge requires evidence-based decisions and evidence-based actions for comprehensive and integrated development and strengthening of health systems.

This is where epidemiology comes in; it fills the need for evidence-based knowledge and information as a basis for such decisions and actions. Epidemiology is the study of factors contributing to health and illness of populations. Epidemiology is an environment - and ecology-based body of knowledge about health and disease, which are multifaceted and multifactoral.

More specifically, epidemiology is about the interplay and the interactions between human hosts, disease agents and their environments. It serves as a rationally logical foundation for public health and preventive medicine.

Through the application of epidemiological principles, health systems are provided with evidence-based knowledge, the most important tool for their functioning. Knowledge about the distribution and extent of health problems and health issues enables them to be tackled through public health interventions. Together with the information on health risks and health determinants, this knowledge will lead to the development and implementation of rational policies and strategies for the provision of effective, promotive and preventive health care to the community.

Evidence-based information can certainly help effectively in advocacy and education for health at all levels, in all populations. This information is also extremely important for education and training of all categories of health workforce.

Ladies and gentlemen;

This Regional Conference on Epidemiology is one in a series of WHO activities in the Region. It aims towards further strengthening of health systems capacity in public health in countries of the Region, so that the countries are able to face today's health challenges more effectively through public health interventions.

With these words, let me finally conclude by wishing you all every success in your deliberations during the course of the Conference.

Inaugural address

Mr Kapil Sibal
Honourable Minister for Human Resource Development, Government of India

Dr Samlee Plianbangchang, Dr Jai P. Narain, Dr Shiv Lal, Dr C. S. Pandav, distinguished delegates, friends in the media, ladies and gentlemen,

It gives me great pleasure to be here on the occasion of the inauguration of the WHO South-East Asia Regional Conference on Epidemiology. There is a law in science which tells us that there can never be a vacuum. So is also in politics, because whenever there is a possibility of a vacuum, it gets filled up. I was wondering when distinguished friends came to invite me for this conference as to why they were doing me this honour as I have very little knowledge of epidemiology. But, I suppose, having been a Minister of Science and Technology, they might have thought that I have a smattering of the subject.

I look at the issue from the eyes of a politician. I do not think that humans can ever be free unless they are healthy. That is the fundamental of life. If you look around the world, I do not think two thirds of the 6.8 billion people have access to health care, the kind of health care that will allow them to have a healthy body and a healthy mind. If you look at the therapeutic remedies that have become available in the last thirty years, only one per cent concern diseases of the poor or diseases that are prevalent in the developing world. Medicine is moving forward without particular regard to the regions of the world where disease is rampant and health is a scarce commodity. There is something wrong with our public health system, not just nationally but globally.

I believe that because of the enormity of the social, cultural and technological changes that we are witnessing, we do not yet know their impact on public health. I sometimes feel that my most constant companion in the family is my cell phone. But I still do not know, what is the impact of cell phone on my physical well-being? I do not think there is yet any evidence-based study on it. The manufacturers of cell phones will give you a host of information on how perfectly safe it is. But I think the extensive use of radio waves and their impact on the body has not yet been fully assessed. This is just an example; it is only to show to you that the field is really open because of the enormity of the change. Unless we are able to develop human resources which are able to gather data and information based on scientific evidence, we will not be able to deal with public health issues.

Look at the kind of diseases that are today afflicting humanity, e.g. noncommunicable diseases such as cardiovascular diseases, obesity, diabetes, cancers and psychiatric illnesses, which are increasing at an exponential rate. We do not know the correlation between these diseases with our lifestyles and with the environment. We need a workforce to be able to understand that correlation. This correlation will differ from place to place and from area to area. You cannot have an epidemiology and policy framework which is a one-size-fit-all thing. The nature of the deleterious impact of the interplay of environment and lifestyle with reference to genetics will vary from population to population, and also from place to place within a large population. Therefore, I do not think you can have a one-size-fit-

all solution. In other words, you will need a national workforce which will actually look at different segments of the population to be able to determine with reference to their lifestyles as to what ought to be done. Socioeconomic factors and lifestyles are involved in most chronic noncommunicable diseases.

I was reading one of the chapters from a book that you have published recently, which relates to the impact of the global economic crisis on public health. I found that to be exceptionally interesting. I learnt as to how the global economic crisis in fact impacts the poorest of the poor because they do not have access to food or the kind of food that has nutritional value. Their capacity to buy food decreases, and, therefore, it impacts their health. The policy framework never looks at this issue because there was no evidence. Pre-emptive steps are not taken in the area of public health in the event of a financial or economic crisis which would help people to deal with the problem in a far more systematic manner. This is just one example as to how the economic system has enormous impact on public health. It is something that we normally do not think about. Certainly, policy-makers are not even aware of this problem.

There was another chapter which dealt with a particular kind of flu that has emerged in one of the south-east Asian countries, which is somewhat as dangerous as the Ebola virus in Africa. You do not know exactly whether that would mutate as it moves along. Many of the challenges that we are going to face in the future are unknown. What are those pathogens that are going to attack us in times to come? How are we going to deal with them? Do we have public health systems that are ready? We found that when the H1N1 came upon us, we did not have a framework to actually deal with it. We still do not have vaccines for many of the diseases that we think we are going to be confronted with in the future.

At this point in time, we need to understand the interplay of genetics with many of these things. Genetic epidemiology is a subject that we need to look at very carefully. We have been through the genome project, and we are able to understand the genetics of not just population but also individuals. We need to study statistical genetics, molecular genetics, human genetics, population genetics and their interplay with epidemiology. It is only through the interaction of these genetic frameworks that we will be able to understand the causes of some of the diseases in a particular population group and then develop preventive measures to deal with those particular kinds of diseases. Some specific genes may influence a particular phenotype while others may not.

I am the Minister for Human Resource Development which deals with education. There is a parallel between how we deal with modern science at the level of academics and how we should deal with health care. The parallel is that if you look at academics today, it is multidisciplinary. You have a biologist understanding not just chemistry but engineering, bioengineering, biotechnology and statistics. There is cross-fertilization of disciplines in order to understand and move forward in academics and to be able to understand very complex issues dealing with science. That kind of cross-fertilization has not taken place in the area of public health to the extent and depth to which it should. I think that kind of multidisciplinary training is required, and that must start at the level of educational institutions. In South-East Asia, I do not think we have those systems in place which cater to that kind of multidisciplinary training. You also need interaction between the community that gathers data and the community that delivers. We need to have a conference that actually looks at these interdisciplinary issues and then come up with solutions as we move forward. We need partnerships without which we will not be able to move forward; partnerships with civil society, with academic community, and with those who deliver health care. These partnerships are exceptionally important. We need to have not just a national but a regional plan for the next 20, 30, or 40 years. It is this part of the world with huge populations that is going to be afflicted by major diseases.

Health care, in the ultimate analysis, is a constant struggle between man and nature. Nature has the unique ability to attack you when you seek to conquer it. It comes back at you when you think you have won. This battle is very difficult to win because we have dealt with nature for some time now in a way we should not have. Nature, therefore, is getting back at us. We do not know how it will impact us. What will the 1.5 degrees Celsius increase in temperature do to microbial activity and human health? What will it do to the marine world? What will the high levels of carbon dioxide do to human health in the long term? What type of pollutants will enter the water bodies from where we draw water on a daily basis?

I go back to what I said earlier: epidemiology is about where and when. We do not know where the effects are going to be. We do not know when it is going to come. We do not know who is going to be attacked. We do not know the extent of damage. The field is open for all of us. We need to develop systems, particularly quality human resources, so as to weather the storm when it comes. But the storm will come. It is up to us to prepare ourselves to face it as best as we can.

I wish your conference all success.

Executive summary and conference recommendations

In view of the serious challenge posed by the emerging infectious diseases, economic crisis, climate change, rising burden of non-communicable diseases, and slow progress in achieving health indicators related to Millennium Development Goals, South-East Asia Regional Conference on Epidemiology, held in New Delhi from 8-10 March 2010, provided an excellent opportunity for debating how epidemiology can address these challenges.

In several plenary sessions, top experts from around the world, shared their ideas and experiences for application of epidemiology to solve public health problems in the South-East Asia Region; nearly 350 participants, ranging from decision makers and public health managers from the ministries of health, teachers and researchers from academic institutions to public health practitioners, members of civil society, and development partners from eleven member countries of the South-East Asia Region, extensively discussed the scope and application of epidemiology for public health programme development and management so as to promote access to health and health care services among the most vulnerable populations. Conference theme-'Evidence to policy and action through partnership' focused attention on the value of evidence informed policy formulation by involving partner organizations and stakeholders.

In the inaugural address, Honorable Minister of Human Resource Development, Government of India, Mr. Kapil Sibal, emphasized the importance of multidisciplinary approaches and partnerships for addressing several public health challenges that confront mankind today; he said "human beings can't be really free unless they are healthy".

Dr. Samlee Plianbangchang, Regional Director of World Health Organisation, South-East Asia Region, highlighted the value of epidemiology as it provides the evidence-base to decision making for public health action.

Enduring relevance of epidemiology was highlighted in several plenary sessions of the conference. In the last one and a half century, epidemiology has not only emerged as the basic and core science of public health but has provided scientific basis to medicine in general. The principles and methods of epidemiology, which were instrumental in understanding the transmission of cholera and eradication of small pox in the past, have recently provided a sound knowledge base for controlling the emergent infections such as SARS, Nipah virus, and pandemic H1N1 influenza. Epidemiologic thinking will continue to be of great value in understanding the causes of unexpected public health events that are likely to happen at higher frequency in future. Plenary sessions highlighted the relevance of epidemiology in the context of Millennium Development Goals and its relevance not only for control of communicable diseases but also the non-communicable diseases, maternal and child health, climate change, and economic crisis etc. Recent developments in the field of computing, information technology, molecular biology, mathematical modeling, and spatial geography offer new

opportunities for application of epidemiology to confront emerging public health challenges in the era of globalization where the pace of geographic movement of people, products, and information has become quite fast.

Epidemiology needs to move beyond the traditional biomedical sciences based approaches to the study of socio-cultural determinants, impact of economic crisis, disasters, and climate change. Participatory epidemiology has potential for mobilizing community action; hence, public access to available data is crucial first step for harnessing the power of epidemiologic analysis. Communication of epidemiologic research findings to policy makers is a challenge which needs to be overcome by building capacity of researchers, policy makers, and civil society for formulation of evidence informed public policies. Uses of epidemiology in identification of needs and priorities for resource allocation, planning, monitoring and evaluation of public health programmes, i.e., the managerial epidemiology, has potential for strengthening public health and primary health care system.

In several parallel sessions, specific issues related to application of epidemiology to the prevention and control of non communicable diseases, preparedness and response to public health emergencies, acute diarrhea and pneumonia, tuberculosis, malaria and AIDS, pandemic H1N1 were discussed to find solutions to these continuing public health problems in South-East Asia Region. Several 'best practices' of epidemiology being used for prevention and control of these diseases were shared in the conference.

Capacity building in epidemiology was identified as an important and urgent issue. Several skill building sessions were conducted for writing research proposals and for communicating research findings to scientific journals, specifically for the young epidemiologists working in the academic institutions, surveillance and public health programs.

Field epidemiology training programs functioning in the Region were reviewed. Expansion of these programs to several institutions while maintaining the quality was emphasized to meet the training requirement of large number of epidemiologists in the Region. Concerns were expressed about inadequate availability of skilled public health specialists, especially epidemiologists in the health services. Development of career structures at various level of health care delivery system was identified as an incentive for attracting talented workforce to epidemiology.

In view of the need for promoting evidence informed policies, strengthening of the surveillance system for planning, managing, and evaluating the effectiveness of public health programs, epidemiological thinking needs to be promoted in the Region. The conference concluded that all member states, in partnership with professional associations, development partners, and civil society organizations should promote epidemiology at all levels to strengthen health system so as to achieve the Millennium Development Goals in the agreed time frame.

In summary, Epidemiology is the foundation from which public health decisions are made, implemented and evaluated. The science of epidemiology, by definition, has human beings at its centre and its applications have universal reach.

The South-East Asia Regional Conference on Epidemiology unequivocally reiterated that principles and practice of epidemiology have:

- facilitated innumerable public health actions in the recorded past starting from the times of John Snow,
- continue to do so in contemporary times of pandemics and paradigm shifts in health scenario including rise of noncommunicable diseases and

– has the potential to provide evidence for making decisions with far reaching implications on lives and health of entire global community who are faced with several new challenges.

Epidemiology has universal appeal. It is the responsibility of all stake- holders to assure its full utilization with focus on poor, marginalized and vulnerable populations. To realize this potential to maximum, several action points or recommendations have emerged from the deliberations in this Conference. These recommendations are targeted for use by individual scientists, and through them by the countries, international developmental partners, UN agencies, and all those who claim to have a stake in assuring a healthy human species.

Recommendations

- Advocate and promote application of epidemiological principles in formulation of evidence based policies, development and implementation of programmes and their monitoring & evaluation to strengthen health system that are efficient, effective and equitable.
- Build capacity for epidemiological analyses, generation of quality evidences and their utilization at all levels in the countries through human resource development and provision of enabling environment for optimal utilization of their skills. Appropriate resource allocation for development of human resource and its continuous improvement is called for.
- Communicate epidemiological data effectively and in a simple and concise language for its rational utilization by the decision makers and other users.
- Disseminate epidemiological data utilizing modern communication tools to promote free global access and utilization of data while safeguarding the rights of the owners of data and appropriate acknowledgment of the work done.
- Expand epidemiological thinking and activities in all sectors that influence health outcomes through advocacy. These sectors pertain to, environment, water, sanitation, public health engineering, humananimal interface, pollution, economy, socio-cultural and behavioural sciences, to name a few.
- Use epidemiological evidence to articulate the impact of socio-cultural determinants including inequities on human health, especially that of poor, children, women and marginalized populations.
- Focus on needs of communities and finding local solutions to their problems through a participatory approach. Success stories at community level should be widely disseminated for their replication in other settings, shaping national programmes and international policies. Recognize that in contemporary times there are multiple users of epidemiological observations who may use it at local, national or global levels.
- Generate epidemiological evidence to evaluate the efficacy of interventions that are currently being applied as well as those which are under development/consideration.
- Prioritize epidemiological studies that facilitate conversion of "research paradigm" to "action paradigm" by initiating actions to improve public health through bridging the gap between what is known and what is actually being done. Synthesize epidemiological data in context of other multisectoral factors that influence its utilization.
- Institute sustainable networks on epidemiological evidences with peers to provide value-added information and also with policy makers and communities for efficient utilization of evidence.

- Promote inter-country/regional collaboration to facilitate exchange of epidemiological data for the overall benefit of entire Region.
- Strengthen efficacy of epidemiology by utilizing modern health (molecular) and information technology tools (GIS, internet, cloud computing etc). Continuous process of improvements in this science should be attempted to augment the accuracy of the evidence and to expand the spectrum and depth of epidemiological analytes
- Address on priority the emerging issues with global ramifications. An example is generating evidence for impact of climate change on human health Undertake modeling exercises to generate evidence-based projections for epidemics of communicable and non-communicable diseases, pandemics and impact of other major events on human health to support realistic planning and timely allocation of resources
- Target epidemiological research in areas of global importance and attention (HIV, TB, malaria, influenza, maternal and child mortality etc) to monitor, interpret and predict trends in their epidemics to craft multi-disciplinary response to achieve Millennium Developmental Goals.
- Organize similar meetings periodically at national and international levels to sustain advocacy and review the progress made.
- Articulate the salient outcomes of this Conference through an advocacy charter viz. Delhi Declaration on Epidemiology

Delhi Declaration on Epidemiology – March 2010

We, the participants of this **South-East Asia Regional Conference on Epidemiology** appreciate the efforts of the WHO Regional Office for South-East Asia to strengthen Public Health in the Member States as a necessary step towards improving the health status of the people in the Region. However**, we note with concern** that even as we complete the first decade of the new century, the **skills of Public Health, including those of epidemiology**, are not universally available to all communities in the Region.

The health systems in the Region are facing **new and complex challenges** with the global financial crisis, climate change, new and emerging diseases, as well as the rising trends in noncommunicable diseases. Public Health in general and **epidemiology in particular** have **a pre-eminent role** in initiating and sustaining **evidence-based interventions** in an endeavour to have efficient, goal-oriented public health action.

Having noted both the extent of epidemiology skills in the Region and the best-practice examples of the role of epidemiology, we endorse the following strategies and actions and **urge** all **Member States, WHO** and Partners to continue their efforts in providing leadership, advocacy and technical cooperation in building partnerships between governments, professional associations as well as UN and bilateral development agencies to jointly advocate and actively engage in **follow-up on all aspects of this Delhi Declaration on Epidemiology**.

1. **Promote** epidemiology as a core discipline of Public Health, and as an essential tool for rational evidence based health action and for addressing, with socio-cultural sensitivity, issues related to equity in health with social justice;
2. **Recognize** the essential role of epidemiology, together with suitable laboratory back-up, in providing evidence-based information, in partnership with health and health-related sectors and the community, for advocacy, planning interventions, monitoring and evaluation in health;
3. **Strengthen** epidemiology and Public Health by creating an enabling environment and establishing career structures at national, state, provincial and district levels. In addition augment capacity by mandating competent background and level of expertise for persons responsible for health of populations;
4. **Emphasise** the use of epidemiology for strengthening health system and primary health care;
5. **Strengthen** and reform Epidemiology and Public Health education, training and research in the Region by all possible means, including establishing regional networks to enable sharing of expertise and information, particularly through the use of modern information technology;
6. **Chalk-out** a time-bound roadmap for achieving these action points to ensure timely contribution of epidemiology to the achievement of health-related MDGs, and
7. **Periodically** review progress in implementation of above action points

About the papers

The proceedings include most of the presentations that were made in the SEA Regional Conference on Epidemiology. Due to unavoidable reasons, five presentations could not be included. To give an overview of these presentations to readers, we are providing here a brief summary of each:

1. *Special Lecture*

Power of free access to public health data for exploration, monitoring and advocacy (Hans ROSLING)

Dr Hans Rosling enunciated novel analyses and demonstration methods for easy comprehension of data. He stressed that the statistical agency/public health institute should standardize the quality of data which should be available in machine-readable format. Society and any category of user should recognize the source of any data for global good. Mechanisms should be established for sharing of the data so that innovation in the use of modern information technology for communicating epidemiological information in an interesting way is encouraged.

We strongly recommend the website http://www.gapminder.org where some of the interesting presentations of Dr Hans Rosling can be accessed.

2. *Plenary on Epidemiology: Ensuring Health Security*

Pandemic (H1N1) influenza: An overview and lessons learnt (Keiji FUKUDA)

Dr Keiji Fukuda described the dynamics of the influenza pandemic (2009) with some of its striking patterns. These included a predilection for complications and deaths among the younger age groups and viral pneumonia as the primary presentation. The important lessons learnt from the H1N1 pandemic are to build into the preparedness plan adequate flexibility and adaptability to events and to obtain public cooperation through effective communication.

3. *Plenary on Research to Policy: Walking on a Bumpy Road*

Epidemiology: A tool for community action (Abhay BANG)

Dr Abhay Bang made a strong case for use of research outcomes in policy formulation. The current model of research, decision-making, policy-shaping and action has too many barriers, and often ends in failure. The community and researchers should jointly identify the problem, collect data, analyse it and share these with the community to solve local problems. He called this participatory epidemiology which can solve local problems and may even shape global policies.

4. *Parallel session on Disease Epidemiology, Modelling and Innovation*

Social innovation and civic participation: A new shape of the development in India (RC MISHRA)

Dr R.C. Mishra highlighted the paradigm shift in India in health services with the private sector acquiring an important role. Innovative methods have been used for the delivery of services which have direct linkages with the social determinants of health. Efficient and successful implementation of this warrants a practical business model.

5. *Parallel session on Disease Epidemiology, Modelling and Innovation*

Agent-based computational modelling in epidemiology (R HAMMOND)

Dr R. Hammond explained agent-based computational modelling in epidemiology in this session.

Section 2

Plenary papers

Plenary 1

The enduring relevance of epidemiology

Chairpersons: *R.K. Srivastava*
Ron Waldman

Session Coordinator: *Rajesh Bhatia*

Epidemiology in action: past, present and future – *David Heymann*

Revitalizing primary health care: how epidemiology can help – *Ravi Narayan*

Epidemiology in action: past, present and future

David L. Heymann

In the mid-19th century, epidemiology was instrumental in elucidating the causation of cholera. During the time of the 1854 cholera outbreak in Soho, London, there were two hypotheses. William Farr, a registrar in the census office, who is regarded as one of the founders of medical statistics, believed that cholera was caused by 'miasma', or poisonous vapour, coming from the open drains of London. Miasma was the dominant theory of disease at the time, until it was later superseded by the germ theory of disease, which emerged in 1861. Meanwhile, John Snow, a leading anaesthesiologist who administered chlorofom to Queen Victoria during childbirth, was a sceptic of the miasma theory and believed that cholera was associated with the local drinking-water, which was pumped from the River Thames. These two great men continuously debated the causation of cholera during much of the mid-19th century. Finally, it was John Snow, who is considered to be one of the fathers of epidemiology because of his work in tracing the source of this cholera outbreak, showed that epidemiology is really an evidence-based science. By talking to local residents, he identified the source of the outbreak as a public water pump on a Soho street. His studies convinced the council to disable the pump by removing the handle. He later drew a map showing how the cases of cholera were concentrated near the water pump, and conducted subsequent studies tracing how sewage-tainted water from the Thames was being delivered to homes. His work is considered seminal to the science of epidemiology – and by many to be the landmark event. He was an evidence-based epidemiologist who not only understood why cholera was occurring but also acted to stop it. Epidemiology in action indeed!

John Snow was not the first to work in public health. In 1796, Edward Jenner developed the smallpox vaccination technique taking pus from cowpox blisters on the hand of a milkmaid who caught the disease from a cow named Blossom, after theorizing that the related but less virulent cowpox infection might explain why milkmaids didn't get smallpox. He inoculated his gardener's son with the cowpox pus, and then did the same to a few other people, and proved that they were immune to smallpox. Vaccination for smallpox spread around the world and became a common practice by the end of the 19th century. Mass vaccination was very effective in industrialized countries, where smallpox incidence was reduced to minimal levels by 1914, but it was still a significant burden in many countries in the southern hemisphere because vaccine was not reaching people there. It was a problem of access, which continues even today for many health-related goods.

In 1967, many countries still had smallpox. It was at this time that Dr Bill Foege, a missionary doctor working in Nigeria, developed a new evidence-based epidemiological strategy of search and containment. Although he was not the first to propose it, he provided convincing evidence of how successful it could be in field conditions. It involved searching for all cases of smallpox—smallpox was always clinically apparent in an infected person—and isolating that person and vaccinating the person's contacts or potential contacts in a ring around where that person was living. The strategy was

to search for cases of smallpox, or rumours of smallpox, from house to house, in markets, or public gatherings, and then to initiate containment activity by targeted vaccination.

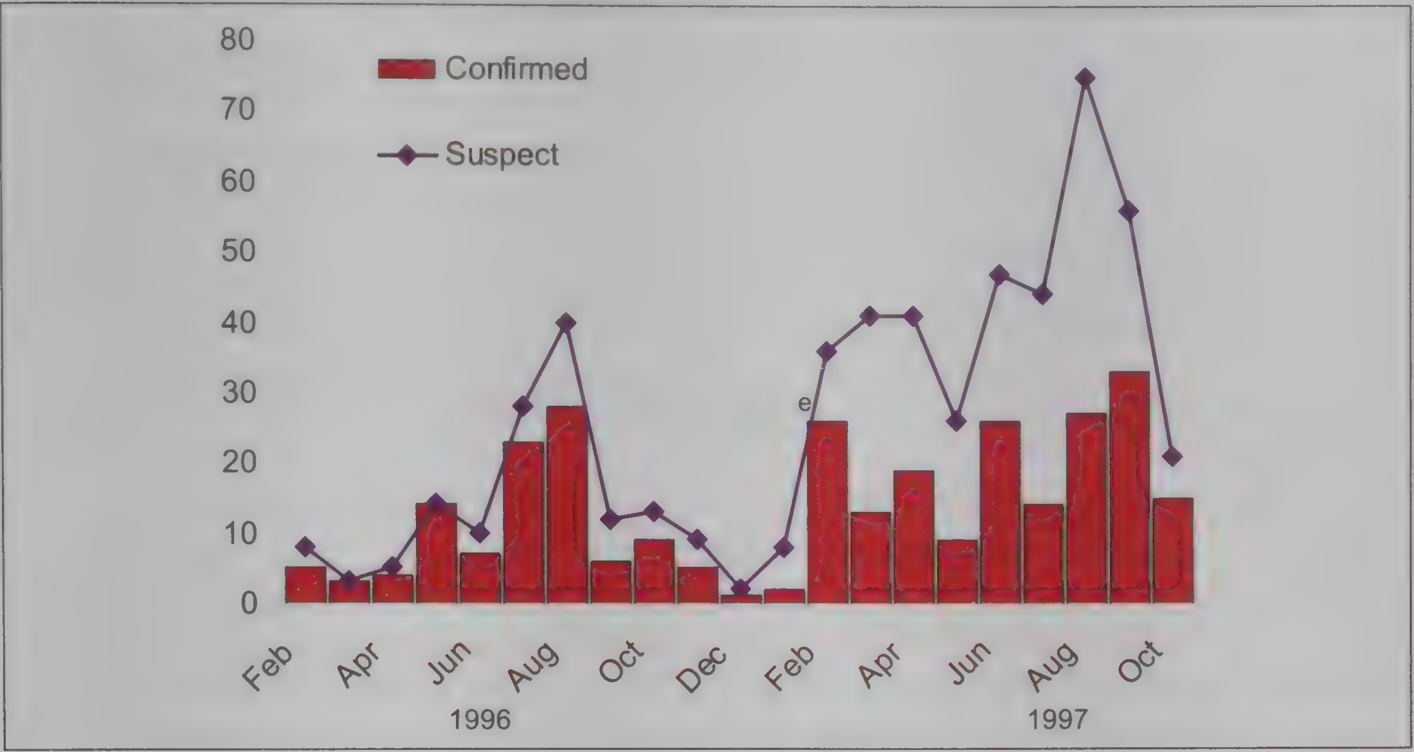
In all countries that still had smallpox, intensified search was conducted using recognition cards for children or adults who had the disease. Investigators recorded names and addresses, information on movements, isolated infected patients and conducted ring vaccination. Towards the end, in many countries, a reward was given in order to find every last case, because if one could find the last case of clinical smallpox, that meant that one had found the last case of infection. The containment activity with smallpox vaccine was very well adapted. It was a heat-stable vaccine which could be carried at temperatures up to 40° C for up to two or three weeks. It was very easy to administer through a bifurcated needle by making punctures in the skin. In 1977, the last case of smallpox in nature occurred in Somalia. The last known case of smallpox occurred in the United Kingdom in 1978 in a laboratory in Birmingham, where a medical historian and librarian working in G block became infected with smallpox, went home and infected her mother and father. Just 30 years ago, in 1980, smallpox was certified as eradicated from the globe.

In 1970, just as smallpox was being eliminated from many African countries, a nine- year-old boy in the Democratic Republic of the Congo, which was then Zaire, developed an infection that looked very much like smallpox. In fact, at that time it was thought to be smallpox. Specimens were sent to the laboratory but it turned out to be human monkeypox, which had been first identified in 1958 among laboratory monkeys in Copenhagen. There was great concern at that time about human monkeypox because it was a disease that looks very similar to smallpox and because it caused death. Some studies were done between 1970 and 1980 showing that 72% of these cases had a contact with an animal in nature. The disease was traced to children picking up dead squirrels or rodents. Three per cent of those children transmitted it to their mothers and others. Between 1970 and 1996, three generations of transmission, and a case-fatality rate of 10%, was observed. Monkeypox was found to be sporadic in West and Central Africa. Primary cases over the age of 15 years were very rare, and secondary and tertiary cases were mainly in unvaccinated parents or siblings. It turned out that smallpox vaccination does protect against human monkeypox disease.

In 1980, it became clear that monkeypox was not such a rare disease. Was monkeypox rising due to smallpox eradication? Humans who had been vaccinated against smallpox appeared to be protected, but smallpox vaccination had been discontinued after the certification of smallpox eradication. Reservoir of monkeypox virus was present in nature in rodents and monkeys. There were sporadic breaches in the species barrier between rodents and humans. Only secondary and tertiary transmission, however, had been observed in outbreaks among unvaccinated contacts. The question was whether the decrease in transmission of human monkeypox after entry into human populations was due to its attenuation with human passage or due to herd immunity from smallpox vaccination campaigns? Also, did monkeypox pose a problem to eradication? Could it eventually replace smallpox? In order to determine answers to these questions, a series of surveys were carried out throughout West Africa. These surveys covered children under 15 years of age, who did not have a smallpox vaccination scar, to see whether they had any facial scarring —which is a sign of human monkeypox—and to check whether their serum had antibodies for orthopox virus. The study included 10 653 children with no smallpox vaccination scars. They were examined and their blood specimens were obtained. None of them had serum antibodies to orthopox virus, i.e. the monkeypox virus. The outcome was that no replacement epidemiology was occurring; hence, smallpox would remain eradicated.

However, in 1996, there was a major outbreak of human monkeypox in the Democratic Republic of the Congo, which had 511 suspected cases of the disease (Fig.1). It continued to appear over several months. The virus was examined genetically and was found to be quite stable. It had not mutated in any way from other viruses collected in the D. R. Congo and other places throughout Africa that had earlier experienced human monkeypox outbreaks. But the epidemiology of the outbreak was quite

Fig. 1: Human monkeypox outbreak, Democratic Republic of the Congo, 1996–1997 (N-511)



different. From 1970 to 1995, the percentage of infection was greater in those younger than 15, but in monkeypox outbreaks since 1996, 85% of cases have occurred in adults. As regards animal contact, 72% of those cases between 1970 and 1995 had been shown to have animal contact, whereas in the outbreaks that occurred between 1996 and 2008, only 23% had animal contact. The secondary attack rate ranged from 3% to 46% and the transmission chain had extended from three generations to nine generations. However, the case-fatality rate remained the same. The decision at that time was to continue with intensive surveillance because the phenomenon of changing epidemiology has a potential human risk. In addition, monkeypox had travelled out of Africa. There was a major outbreak, a multi-state outbreak, in the United States linked to imported rodents from Africa, which were kept in cages next to prairie dogs that were being sold as pets.

Just as smallpox disappeared in 1980, a new disease —HIV—was identified. It is very interesting to see that as one disease disappears, another appears. We are lucky that the two diseases did not coincide. This is illustrated by a case in 1984 when a U.S. Military recruit, who had undiagnosed HIV, was vaccinated against smallpox. He developed generalized vaccinia and died of an AIDS-defining event 18 months after vaccination. It is known today that smallpox vaccine cannot be safely used in HIV-infected persons. Today, if smallpox was to be eradicated with the vaccine that was available then, it would have to be in a programme that examined people for HIV infection, and smallpox vaccine would be given only to those who are not found to be infected with HIV. It would have been almost impossible to eradicate smallpox. Think of the window of opportunity that was taken advantage of for eradicating smallpox without even knowing that the window of opportunity existed.

Smallpox virus does still exist in two locations; in maximum security laboratories in Atlanta in the USA and Koltsovo in Russia. But, in 2000, there were reports from people who had been working in Russia and had migrated to other countries that this virus was not only in the laboratory in Koltsovo but also outside that laboratory, being used in research and other activities. At that point, Member States of WHO asked the Organization to update its guidance on smallpox prevention and control because industrialized countries were stockpiling vaccine in case smallpox virus was used maliciously. Intensified research on new, safer vaccines and diagnostics began and continues in the

USA and Russia. The full circle is complete; after eliminating the naturally occurring risk of smallox through eradication, it is again considered a risk, but now from malicious use.

There are many lessons to be learned from smallpox eradication. First, infectious diseases have complex dynamics and are often associated with animal contact. This has been seen in the evolution of human monkeypox, with gradually shifting epidemiology, and the epidemiology of smallpox, with its vaccine being no longer effective in the era of HIV. The second lesson is that the potential threat of any organism may not be known at the time of identification or emergence. Third, health and laboratory workers are at risk of spreading infection to family members, as was the case of the medical librarian in Birmingham. The potential exists for international spread, as has occurred with human monkeypox, and political issues can crop up, as happened with worries over the possibility that the smallpox virus, held outside laboratories, could be used to engineer weapons (although this has never been verified by WHO).

These lessons from the past also apply to the emerging infectious diseases. First, consider the complexity of infectious diseases and their association with animals. It is believed that most of the emerging infectious diseases that occur today occur at an interface between humans and animals, whether they are coming from the wild animals or the domestic animals. At the same time, these emerging diseases occur with bacteria, virus, and fungi; several classes of microorganisms are emerging pathogens. Various outbreaks that have occurred between 1940 and 2004 show that in an emergence, there are many potential pathways of transmission. For example, an organism may jump the species barrier to humans and not transmit further from human to human; it may emerge in humans and continue transmission for a few generations and then attenuate and stop, such as is seen with the human monkeypox virus; or it may emerge and sustain human-to-human transmission to become endemic, as HIV did. Each emergence has many possibilities. These possibilities are really the bread and butter of epidemiologists.

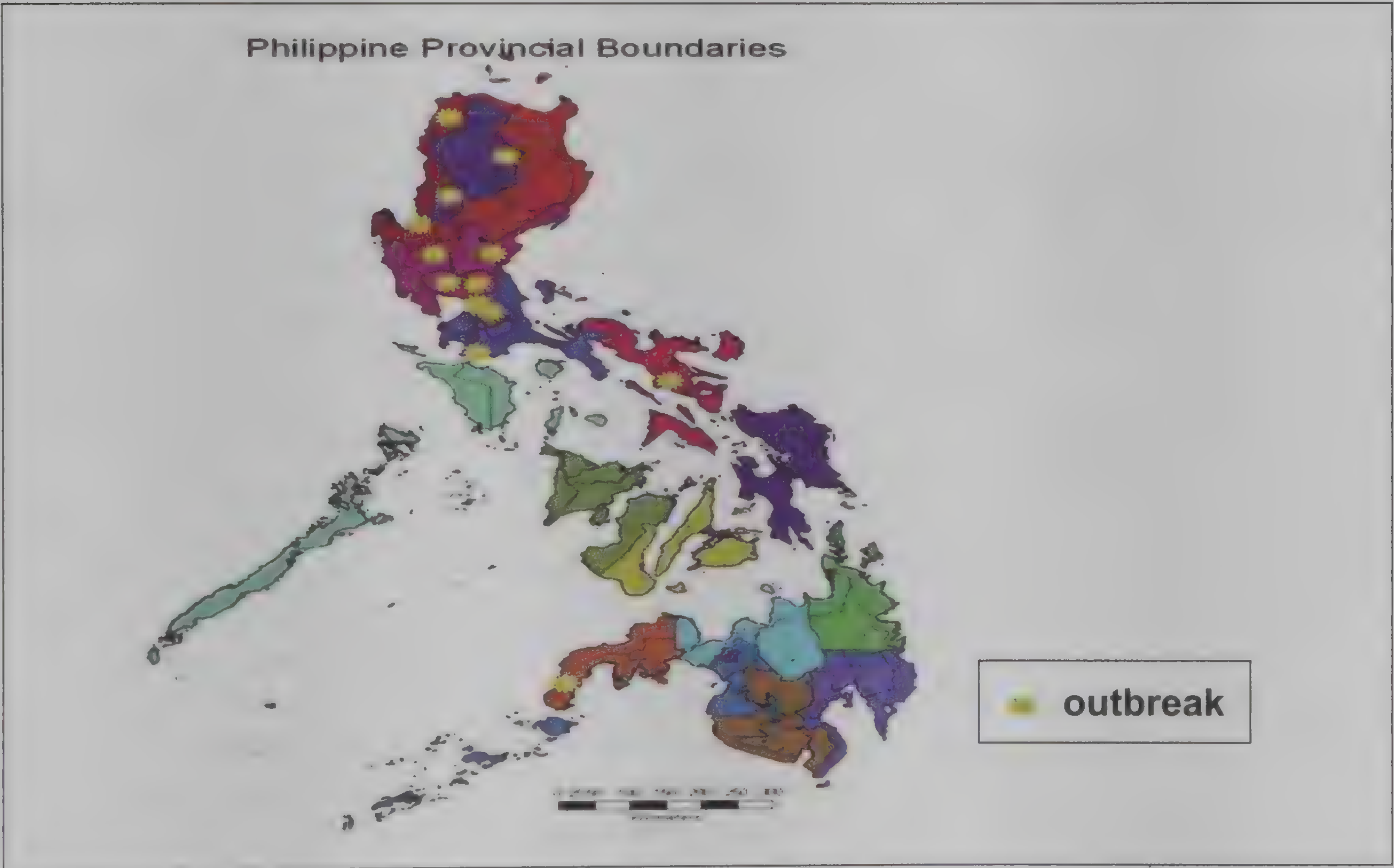
Since 1997, the H5N1 influenza virus emergence has been, and continues to be, a major threat to public health. It has spread throughout the world. H5N1 is occurring in poultry in many countries alongside the human infections with H1N1. This virus is also mutating. It has never been a stable virus. One threat is when adaptive mutation occurs in other mammals. The other is a rapid event, of the kind that might have occurred in 1957, when the H1N1 virus was circulating in humans and an H2N2 virus from a duck or other waterfoul somehow found an intermediate host also infected with H1N1. The two viruses then reassorted, and the virus became the H2N1 that caused a pandemic. The epidemiologists must continuously be watching what could happen and what the potential is.

The Nipah virus was first identified in 1999 in Malaysia. It was found during a Japanese encephalitis outbreak that was killing the farm workers who were working with swine. The virus then spread to Singapore as well. In fact, the theory is that this virus comes from fruit bats, through domesticated swine to humans. This is a very real example showing the complexity of microbial world and the animal human interface. There have been several Nipah virus outbreaks since 1998 (Table 1). What is alarming with this virus is that human transmission was first suspected in 2001. Prior to 2001, every human case could be accounted for either in a professional working near swine populations or slaughterhouse workers. But in 2001, it was suspected in India that there was human-to-human transmission within a hospital setting. Human-to-human transmission was suspected again in outbreaks in 2003, 2005 and 2007. This was suspected because the hospital cases could not be linked to domestic animal exposure. Only one case could be identified that might have been an index case with potential exposure to bat urine or guano in palm wine. He had climbed palm trees to get the palm wine. It is not clear what had infected the palm wine. This is another virus which epidemiologists have to continue to track because the risk to human health is poorly understood.

Table 1: Nipah virus outbreaks, 1998-2008

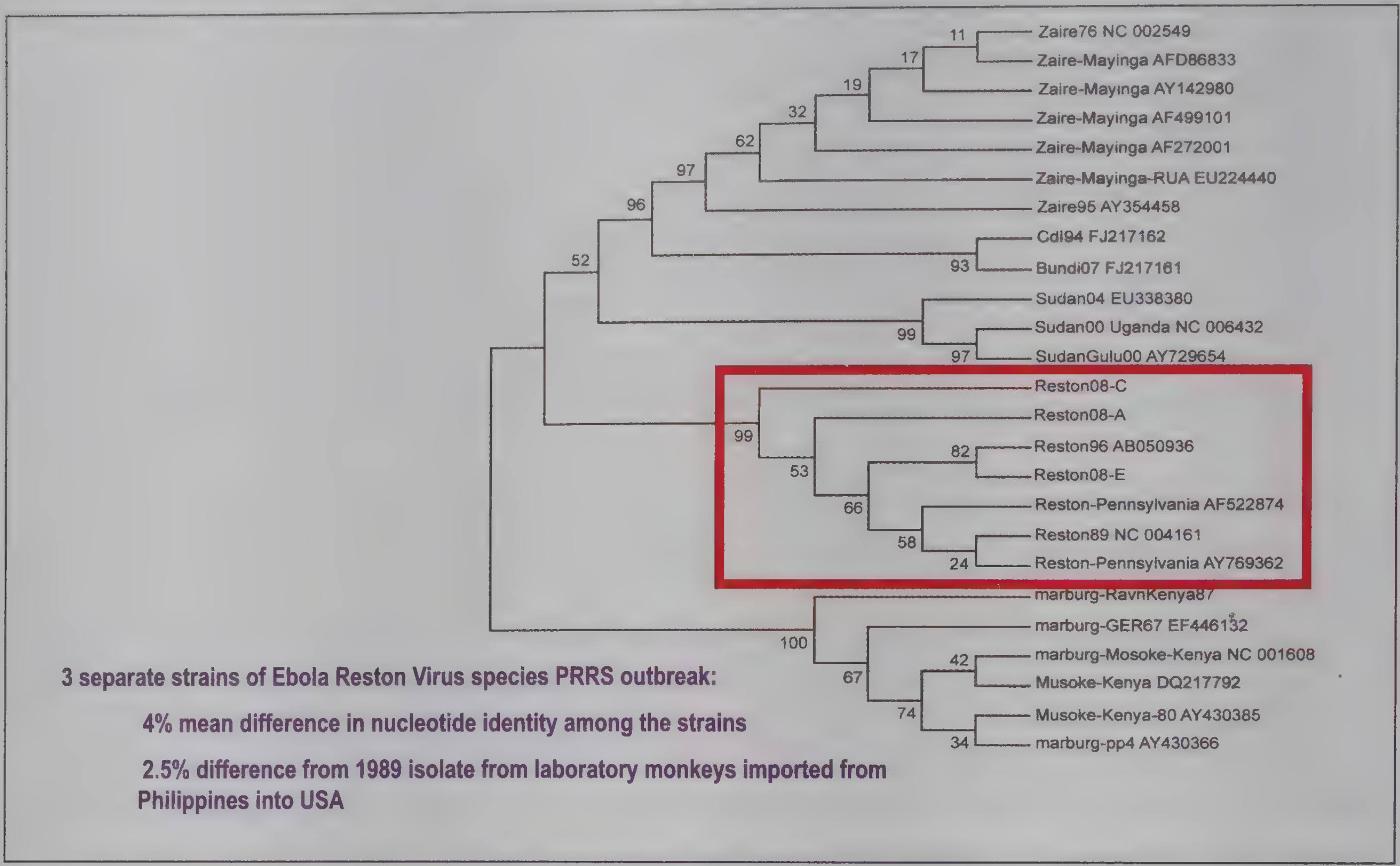
Dates	Location	No. cases	No. deaths	CFR(%)
1998-1999	Malaysia;	265	105	40
1999	Singapore	11	1	9
2001	W. Bengal, India	66	45	68
2001	Bangladesh	13	9	69
2003	Bangladesh	12	8	67
2004	Bangladesh	29	22	76
	Bangladesh	36	27	75
2005	Bangladesh	12	11	92
2007	W. Bengal, India	5	5	100
2007	Bangladesh	15	8	54
2008	Bangladesh	11	6	54

Fig. 2: Philippines, Porcine Reproductive and Respiratory Syndrome, July 2007–June 2008



In the Philippines, in 2007 and 2008, there was an outbreak of porcine reproductive and respiratory syndrome, a disease that is fatal in pigs. These outbreaks occurred throughout the northern part of the Philippines but also in some of the southern islands (Fig. 2). When swine tissue specimens were examined, the porcine reproductive and respiratory syndrome (PRRS) virus was diagnosed, but examination by electron microscopy showed a filamentous virus particle, which is very alarming because this is the family from which the Ebola Reston virus (ERV) comes (Fig. 3). It was discovered

Fig. 3: Ebola Reston Virus, 1998-2008

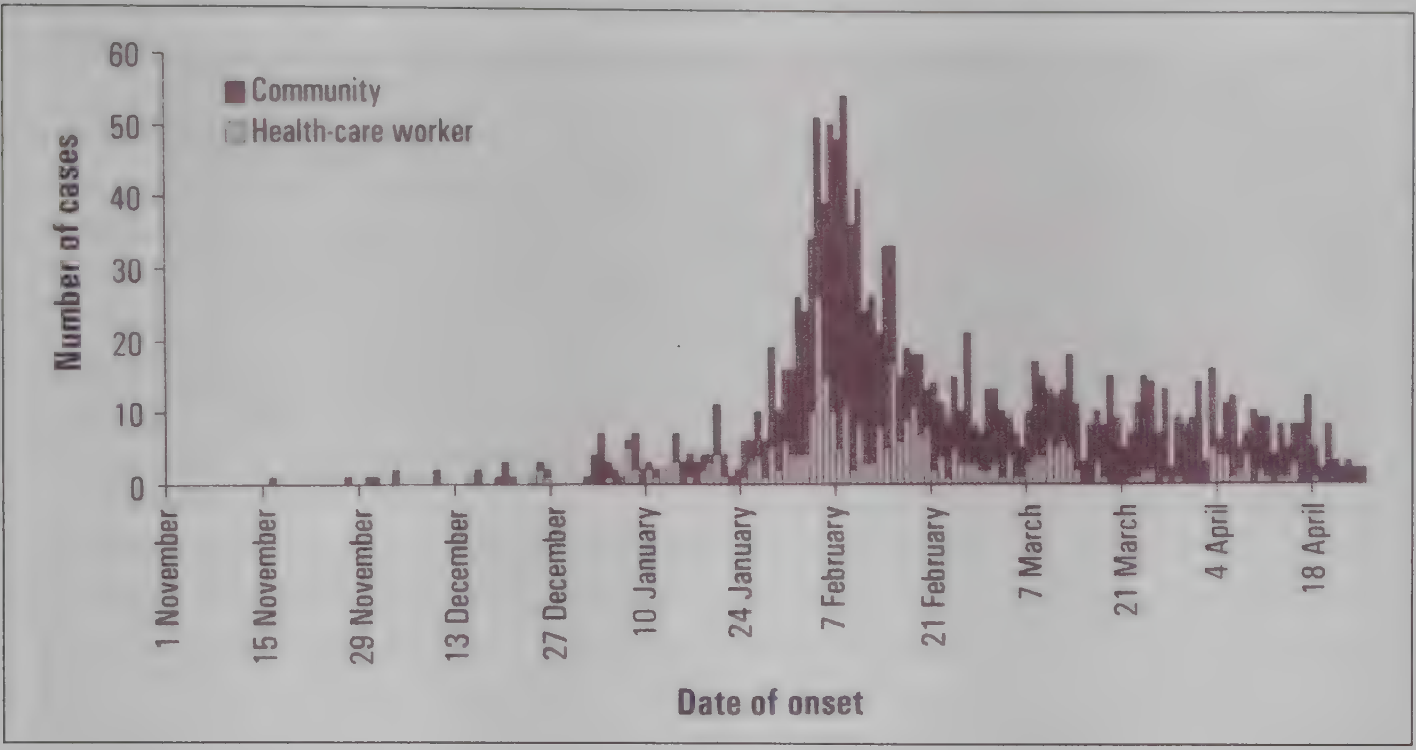


that this virus was an ebola-type virus that falls under the genetic branch of ebola viruses that have been isolated in North America and in the Philippines. Unlike the human monkeypox viruses, this virus is not so stable genetically. Until 2008, there were only 25 known infections of Ebola Reston virus (ERV), all of the cases had exposure to sick monkeys, and none had significant illness.

After 2008, among workers who were working in either farming or backyards or a slaughterhouse, it was found that there were many who were positive for ERV. A further survey was done among 70 workers and pigs at the slaughterhouse. Among the 70 pigs, 19 (27%) were found to be PCR positive for the ERV in their blood specimen. Nineteen PCR-positive pigs did not show overt illness but 13 of their spleen samples and 12 lung samples were positive for ERV. The risk assessment on this virus is still going on. The risk for humans is low to moderate and the uncertainty is moderate to high. This virus, which is now in human population, is not well understood, hence monitoring is required. It may come to pig populations from bats, and it continues to circulate in the Philippines. It is again a very important disease that epidemiologists need to continue to watch. Health workers in health-care settings and laboratories are at risk of spreading infection to family members. The last case of human smallpox was a worker in a medical setting. Nothing illustrates this more clearly than the index case of the severe acute respiratory syndrome (SARS) outbreak: a provincial doctor stayed in a hotel in Hong Kong SAR, infected people in that hotel and then it spread around the world. Until late 2002, hospital workers were not infected, but by December 2002, they began to become infected. It was hospital workers who spread the outbreak into the community through their family members and then to others. It has been seen in many emerging infectious diseases that the health workers are at great risk. During the SARS outbreak, it was not only in China, but also in Singapore and Hong Kong SAR that many health workers were infected (Fig. 4). Emerging infections are a great risk to people in hospitals and health facilities.

The potential of international spread certainly exists for many infectious diseases. The Eco-Challenge in Malaysia organizes running through jungles, swimming down rivers and bicycling in mountains.

Fig. 4: SARS epidemic curve, China, 2002-2003



In the 2000 Eco-Challenge, 33 of the 312 participants returned to their home countries infected with leptospirosis. Fortunately, leptospirosis does not transmit from human to human and there were no outbreaks in the home countries. Many were diagnosed with difficulty by their physicians, and some died. In a globalized world, humans carry diseases from one part of the world to another. Diseases also get transferred in insects; for example "airport malaria", where people who live near airports but have not travelled become infected with malaria transmitted by mosquitoes travelling in an airplane from a developing country to an industrialized country. The export of cattle, food and many other products around the world is also responsible for the spread of infectious diseases. In the 1990s, the United Kingdom had an outbreak in cattle called mad cow disease. The cattle and cattle bi-products, however, continued to be traded because it was not known that this organism could infect humans. In fact, it was only in 1995 that it was found that humans could be infected with this organism. Another striking illustration of how diseases can travel in the modern world is the case of eagles smuggled into Belgium in 2005 that were found to be infected with the H5N1 influenza virus. We live in a world where globalization is rapidly moving infectious diseases that emerge in one place to other locations across the world in humans, insects, food, animal products and animals.

Political issues can also hold pathogens hostage, as occurred over the bioterrorism worries with the smallpox virus. Polio eradication offers another good example of how a pathogen can be held hostage. In 1988, polio eradication began with approximately 1000 children being paralysed each day in 125 countries because of inequitable access to polio vaccine —just as had occurred with smallpox. However, by 2003, there were less than one thousand children infected in the whole year and only six countries remained endemic, i.e. India, Pakistan, Afghanistan, Egypt, Israel and Nigeria. But in 2003, the Governor of one of the northern states in Nigeria had heard of rumours circulating on the Internet that polio vaccine was being used to sterilize young girls in certain parts of the world to limit population growth. He immediately stopped all vaccination activities in northern Nigeria. In no time, 19 countries that had been polio free began to be re-infected from Nigeria, mainly through the trade routes and Islamic religious groups all the way into Mecca, Saudi Arabia, and to Indonesia. The Organization of Islamic Conferences took this very seriously and developed a series of resolutions and

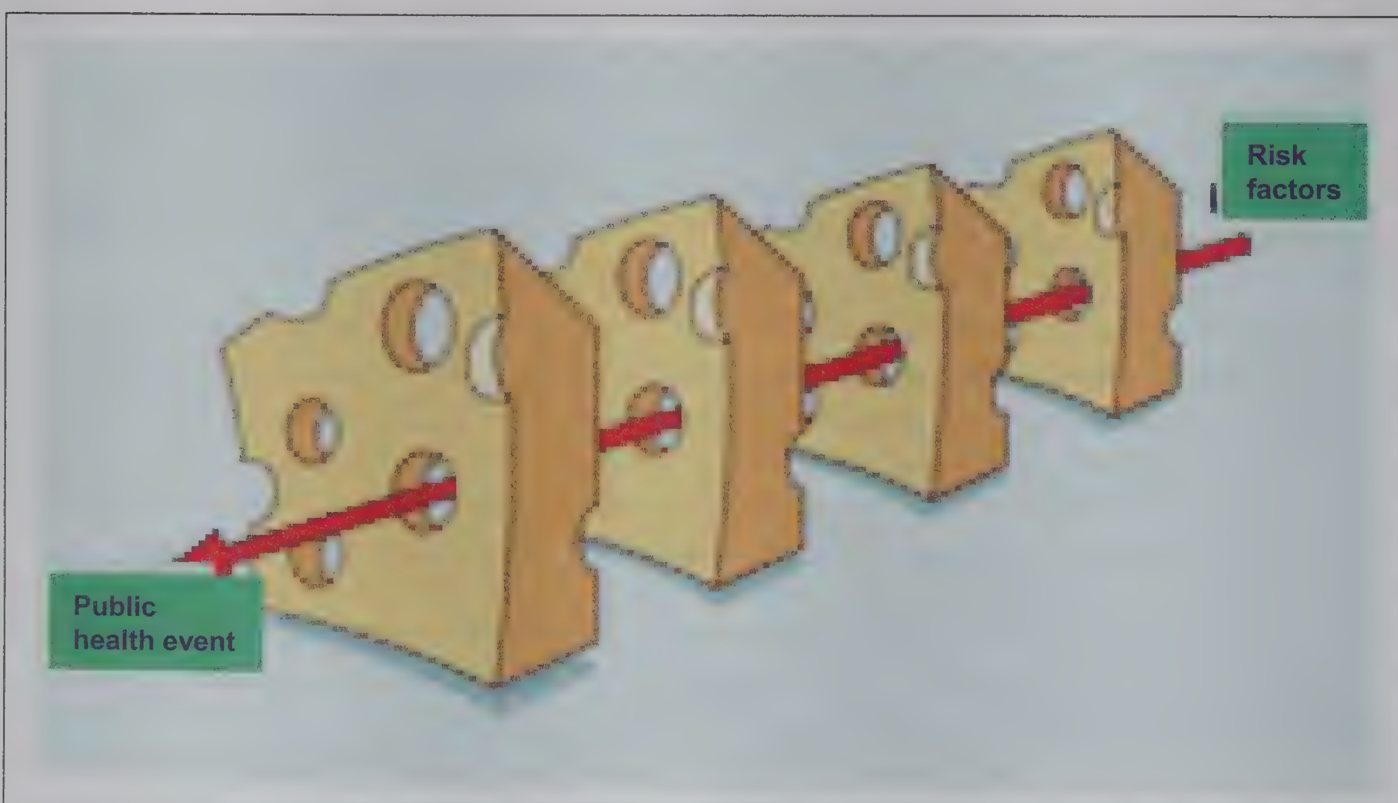
put their political will behind re-beginning of polio vaccination in northern Nigeria. Religious leaders from around the world also began to issue declarations (*fatwas)* and actually visited northern Nigeria to get polio eradication back on track. It is back on track, although polio continues, at times, to spread from Nigeria to neighbouring countries.

Another issue in which a pathogen has been held hostage in south-east Asia Region is H5H1. The Minister of Health of Indonesia noted that, in many instances, those countries that freely share virus samples do not have access to vaccines, which are made with the knowledge derived from those virus samples. This virus has been used as a means of leverage to see if there is a mechanism that can be developed to make sure that vaccine is provided to countries on a more equitable basis. This resulted in a World Health Assembly resolution in May 2007 that led to a series of intergovernmental meetings that are still going on, to address virus-sharing and access to vaccines. Many might say that it is not right to hold the pathogen hostage, but whatever is one's opinion, the issue raised in Indonesia is valid and needs to be addressed by the global community.

Epidemiology in the future needs to be prepared for Swiss cheese events. Swiss cheese is a cheese with many holes in it (Fig. 5). If there are four pieces of Swiss cheese and one wants to pass an arrow through those four pieces, the holes need to be lined up. That is exactly what needs to be learnt in future in epidemiology, i.e. lining up the holes in advance. Several risk factors that are occurring can align in such a way that a public health event occurs.

The Rift Valley Fever outbreak in Sudan in 1998 has given us a glimpse of the future in epidemiology. A major outbreak of Rift Valley Fever occurred in East Africa in 1998 because of a series of Swiss cheese events. First, there was an El Nino event which caused flooding. When flooding occurs, humans and animals move closer together. As they move closer together their contact is increased. At the same time, the water gives space for mosquito breeding. These three events - a disease carried by cattle, which transmits to humans either during a butchering process or from human-to-human by mosquito - were all occurring; and three holes were lining up. There were more holes in that Swiss

Fig. 5: Epidemiology in the future: be prepared for Swiss cheese events



Source: James Reason: Human error: models and management BMJ 2000;320:768-770

cheese that lined up as well. One of those was the routine vaccination programme of cattle against Rift Valley Fever in East Africa. This programme had been a very healthy thriving programme with vaccine produced in Kenya. But vaccine production was insufficient in the 1990s and, as a result, the cattle were no longer being vaccinated. So, another hole lined up in the Swiss cheese. But the story does not end there. Animal husbandry and trade are vital in Sudan. The unvaccinated cattle from the Sudan were exported. There are larger ships that carry legal trade, which requires that cattle must be vaccinated before they are transferred across the Red Sea. But there is also an illegal trade where cattle, sheep and other animals are taken across the Red Sea for slaughter, especially at the times of religious pilgrimages. These cattle are thought to have entered into Yemena, the final hole in the Swiss cheese was lined up, and an outbreak occurred in animals in Saudi Arabia and Yemen. The disease is now endemic in the Arabian Peninsula.

Many risk factors will continue to line up in the years to come. Epidemiologists must be prepared for those Swiss cheese events. The science of epidemiology has served us well in the past, making it easier to address the current challenges posed by emerging diseases. It will also be of immense use to follow and understand the lining up of the holes in the Swiss cheese in the future.

Revitalizing primary health care: how can epidemiology help?

Ravi Narayan

A recent guideline in a declaration *(1)* made by the Consultation on the Application of Epidemiological Principles for Public Health Action, organized by the WHO Regional Office for South-East Asia in February 2009, states that, "The scope and reach of epidemiology which is an integral part of public health must be expanded to include the study of the social, cultural, economic, ecological and political determinants of health and constitute the keystone for use of evidence for development of public health policy." This guideline summarizes the main point of this paper that explores the shift in the paradigm of epidemiology which is required if this discipline has to support the revitalization and renewal of primary health care that is taking place today.

In 1978, when the Alma Ata Declaration *(2)* was announced, the focus of epidemiology was on vaccine-preventable diseases, tuberculosis, mother and child health, environmental sanitation and other diseases, primarily communicable, often described as the diseases of poverty and underdevelopment. Epidemiologists, in the early years of the primary health care (PHC) era, focused on communicable diseases and maternal and child health problems, with a more orthodox approach of watching mortality and morbidity trends of these problems, resulting in single-disease approaches and programmes. While the Alma Ata Declaration also emphasized new concepts such as equity, appropriate technology, intersectoral development, community participation and health as a right, the true significance of these radical concepts was lost among public health practitioners, policy-makers, epidemiologists and researchers in those days.

In the years that followed, noncommunicable diseases, including cardiovascular diseases, diabetes, mental health, and occupational/environmental health problems emerged as newer priorities. These newer, more complex challenges led epidemiologists to identify broader determinants like lifestyles, behaviour, individual and collective risks and other such factors, that led to more broad-based health promotion and risk amelioration strategies.

Today, the primary health care challenges at community level in a country like India include agrarian distress exemplified by both growing childhood malnutrition and farmers' suicides; economic downturns that affect primary health care systems; and climate change, war and social conflicts and other disasters that affect the broader context in which primary health care systems are developing and need to be sustained. These require epidemiologists to be able to study factors such as poverty, inequality, exploitation, violence and marginalization and make epidemiology relevant to the new challenges. It will require a shift towards a new paradigm.

What is this new paradigm in epidemiology and what is the evidence required to study and understand this new context? To answer this question, I share in this paper three short reviews that will illustrate the challenges to epidemiology today, especially in the context of community-based comprehensive primary health care.

- The first is a gradual evolutionary journey of the Centre for Public Health and Equity, Society for Community Health Awareness, Research and Action (SOCHARA), Bengaluru, India, trying, over two decade, to understand this epidemiological complexity in both situation analysis and health programme response. This journey was a study, a reflection and action experiment at the interface between the public health system and the community.
- The second is a brief overview of some of the emerging dialectics within epidemiological thinking at the theoretical level as it grapples with the increasing complexity, moving from the epidemiological understanding of disease to the epidemiology of determinants and structures in society.
- The third is a brief outline of some recently published key documents that are beginning to reflect this paradigm shift in public health and epidemiology.

Finally, I shall illustrate through a few evolving diagrams how epidemiology can metamorphose to be more supportive of the current policy imperative of a revitalized primary health care system.

The journey towards a new paradigm

We began our journey into understanding the community-based challenges and framework of primary health care in the pre-Alma Ata years in the department of community medicine in a medical college in south India. We worked at the community level using health cooperatives, local health workers and partnership strategies with the government and the community to enhance the goals of primary health care *(3,4)*. This led to expanding the range of primary health care activities to preventive and promotive services, appropriate technology and development activities. We were, however, constantly faced with the dilemma before most PHC workers, realizing early in their action-response that the biomedical response was inadequate for a more complex social/community context of the PHC challenge. Cough syrup as treatment for a patient with chronic cough is inadequate for the cough which may be linked to poverty, injustice, lack of protective facilities at home and work, myths, social exclusion and other factors that may be important determinants of the chronic condition.

We were inspired by the work of two professors whose research work symbolized a shift from a biomedical paradigm to a socio-epidemiological paradigm.

Prof. D. Banerji of Jawaharlal Nehru University, New Delhi, worked in 17 villages in India, in the 1980s, visiting them year after year to understand their experiences and perceptions of health and health services. He concluded that, "Health service development is a social-cultural process, a political process, a technology and managerial process, with an epidemiological and sociological perspective" *(5)*.

Similarly, Prof. Geoffrey Rose, an illustrious epidemiologist at the London School of Hygiene and Tropical Medicine, well-known for his work on salt and hypertension, wrote a treatise after a very successful career in teaching and practising epidemiology that, "The primary determinants of disease are mainly economic and social and… medicine and politics cannot and should not be kept apart" *(6)*.

One of our team members used the approach of these two professors to study tuberculosis as a community health problem. In this doctoral study, over 200 patients who had been labelled as 'defaulters' of the TB treatment programme in rural districts of Mysore in Karnataka, were interviewed to understand the processes leading to the default. Many social, economic, political and cultural factors were identified which distorted the TB programme. From all the evidence gathered, a new framework of the understanding of TB and its causation was hypothesized, which covered different levels of analysis and each level of analysis, leading to a different level of control strategy (Table 1). The study also made a critique of the recently introduced directly observed treatment, short-course (DOTS) programme from a socio-epidemiological point of view, identifying its limited biomedical focus and suggesting a community-based reorientation. From DOTS to community-oriented treatment service (COTS) was the suggested paradigm shift *(7, 8)*.

Table 1: Researching levels of analysis and solutions for TB: a common health problem

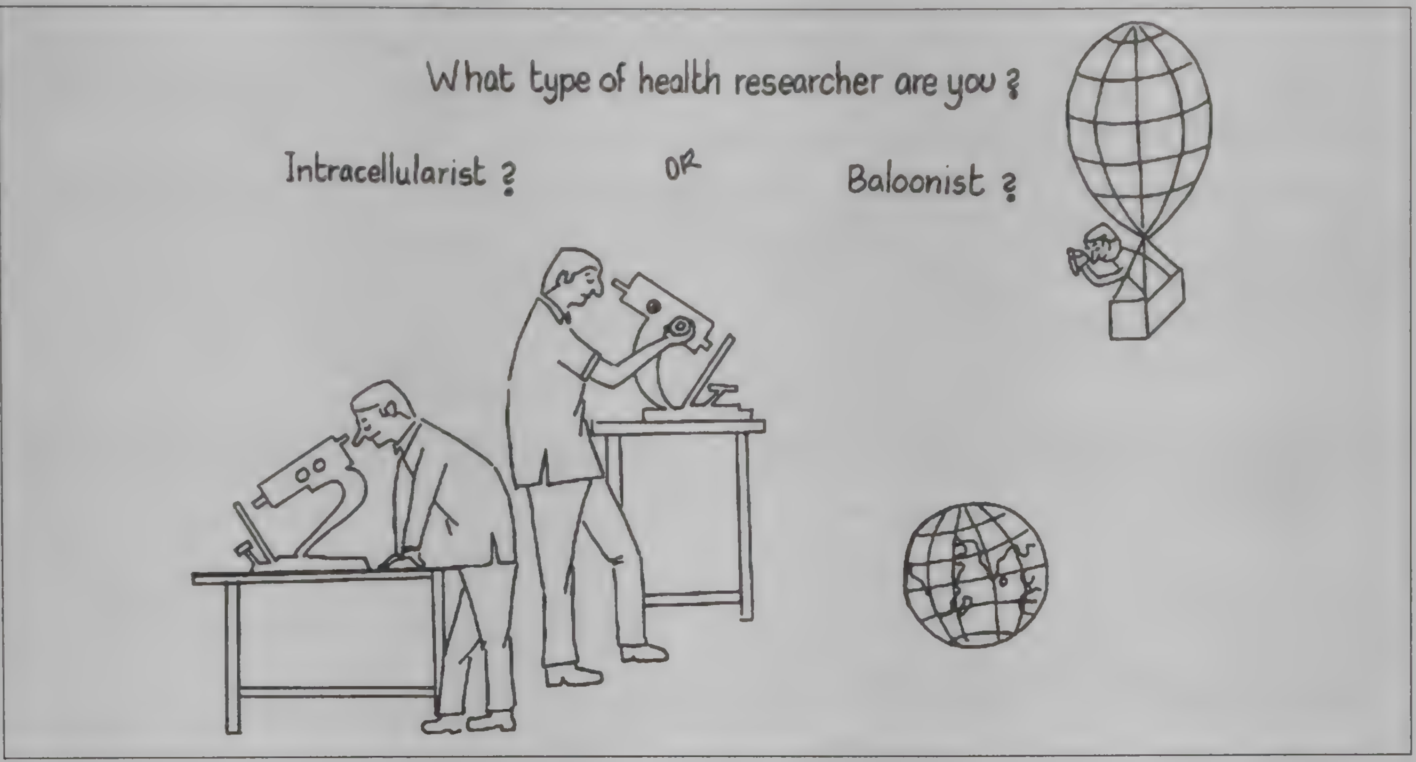
Levels of analysis of tuberculosis	Causal understanding of tuberculosis	Solutions/Control strategies for tuberculosis
Surface phenomenon (medical and public health problem)	Infectious disease/germ theory	BCG, case-finding and domiciliary chemotherapy
Immediate cause	Under-nutrition/low resistance, poor housing, low income/ poor purchasing capacity	Development and welfare – income-generation/housing
Underlying cause (symptom of inequitable relations)	Poverty/deprivation, unequal access to resources	Land reforms, social movements towards a more egalitarian society
Basic cause (international problem)	Contraindications and inequalities in socio-economic and political systems at international, national and local levels	More just international relations, trade relations, etc.

Source: Narayan T,1998

Many researchers of PHC constantly identify such social, economic, political and cultural determinants in their studies but fail to interpret their significance or integrate this evidence into an evolving solution. For example, an excellent study *(9)* on bednets use in a malaria programme among *adivasi* (tribal) people in Mandla, Madhya Pradesh, identified that 60% of the people were outside the bednet at peak mosquito biting time due to survival tasks linked to their economic activity. A follow-up over six months of those who used the net identified many cultural, economic and climatic reasons for the non-use of nets. The evidence that has been gathered by the epidemiologists of the malaria centre was an excellent social evidence, indicating poverty, survival, marginalization and cultural determinants that affected the decision-making process of the *adivasis*. Unfortunately, the researchers used this evidence in a more orthodox way, interpreting the evidence as factors to be included while social marketing the use of nets to the affected population rather than using the evidence to link bednet programmes to women's health cooperatives, income generation and community empowerment initiatives, as has been done by civil society groups in Orissa and other states.

It is a challenge for epidemiologists to move beyond superficial epidemiology that focuses in an orthodox way on the biomedical aspects of a health problem and therefore results in techno-managerial programme solutions, to a deeper assessment and measurement of social, economic, cultural, political and ecological evidences that will enable them to look at deeper determinants of ill health like poverty, gender bias, conflicts, stigma and social exclusion. They should evolve social and community interventions to respond to this larger framework of understanding. Many health professionals who look at these deeper social determinants and social solutions are often labelled as health activists, whereas they are actually socio-epidemiologists who look at the determinants of an unhealthy society in a holistic manner rather than just disease and individual ill health. Prof. Denis Burkitt (well-known for the epidemiological description of Burkitt's lymphoma in Africa) described this dichotomy in the 1970s by creating two categories of public health professionals – "floor moppers" and "tap turners off"— and two categories of public health researchers – "intracellularists" studying the molecular basis of disease and health in their quest for new drugs and vaccines and "balloonists" studying the determinants at community and societal levels (Fig. 1). These are the types of future epidemiologists urgently needed with special skills and social sensitivity to support PHC challenges at community level.

Fig. 1: What sort of researcher do you want to be?



Source: Community Health Cell

In 2000 , SOCHARA was an active participant in a gathering of primary health care enthusiasts, public health professionals, epidemiologists and health and social activists from 75 countries, who had gathered in Bangladesh for the first People's Health Assembly, to assess and explore why the Health for All by the Year 2000 goal had not been achieved. The People's Health Charter (10), which evolved as a situation analysis and an action manifesto, presented a new epidemiological framework for public health professionals and policy activists. It reiterated that, "Health is a social, economic and political issue and a fundamental human right", and that, "Inequality, poverty, exploitation, violence and injustice were at the root of ill health". Based on this new socio-epidemiology, it prescribed actions that tackled the economic, political and social challenges of health; countered war, conflict, disaster and environmental health challenges; and promoted a people-oriented health care based on the rights paradigm. Since 2000, two alternative world health reports - Global Health Watch-I and Global Health Watch-II - have provided the socio- epidemiological evidence to back this new framework of health and health action (11). Professors and researchers from all over the world have contributed their evidence and analysis to these documents and reiterated the challenges of the multidisciplinary evidence that epidemiologists must begin to measure and analyse to support public health policy.

Presently, SOCHARA is a part of a global initiative collecting evidence on comprehensive primary health care (12). A study is being done on six projects in India, Bangladesh, Pakistan and Iran to look at gender challenges in primary health care, the role of health workers (the Accredited Social Health Activist of the National Rural Health Mission in India and the behervaz in Iran), the role of community mobilization and empowerment, and the multiple approaches to urban primary health care. This research partnership will try to take its epidemiology into social, economic, political and cultural determinants to widen the understanding of PHC. This is an urgent policy imperative in line with the Bamako Declaration, which encouraged greater partnership between civil society and academia.

The dialectics of epidemiology

A brief overview of debates and discussions on new eras and new paradigms of epidemiology in scientific literature since the mid-1990s, shows that the dialectic towards a deeper framework for epidemiological analysis is also emerging in academia.

An interesting paper *(13)* published in 1996 identified the shift in the paradigm of epidemiology to four phases - the sanitary era, the infectious disease era, the chronic disease era and the eco-epidemiology era - and described the paradigms for each era, the analytical approaches during each era, and the preventive approaches that emerged as a result of this understanding and analysis (Table 2).

Table 2: Future of epidemiology eras and paradigms

Era	Paradigm	Analytical approach	Preventive approach
Sanitary[1]	Miasma	Clustering of morbidity and mortality	Drainage and sanitation
Infectious disease[1]	Germ theory	Lab isolation and experimental transmission	Vaccines and antibiotics
Chronic diseases[1]	Black box	Risk ratios of exposure to outcome	Control risk factors
Eco-epidemiology[1]	Chinese boxes	Analysis of determinants and outcomes at different levels	Information and bio-medical technology
Socio- epidemiology[2]	Multilayered/ Multicentric circles	Social, economic, cultural, political and ecological analyses	Social vaccine and community empowerment through CPHC

Source: [1]Susser M, Susser E, 1996; [2]Narayan R, 2006; Baum F et al. 2009

More recently, a group of socio-epidemiologists has built an understanding inspired by the Alma Ata Declaration and the people's health charter, evolving the concept of the 'social vaccine' and the epidemiological analysis that is required to understand and evolve it *(14, 15)*.

Another interesting paper in the mid-1990s has compared traditional epidemiology with modern epidemiology and identified the increasing problem of the directions in which modern epidemiology has progressed, which has the focus on the individual, organ, tissue, cell and molecule; on the clinical trial; a positivist, epistemological approach, and a reductionist epidemiological strategy with an increasing focus on the individual rather than the collective *(16)*. What is interesting about this paper is the call it makes to 'go back to the epidemiology of John Snow'. This traditional epidemiology was public health-oriented and population-based, historical and cultural in its context of study, linked to the paradigms of demography and social science: realist in its epistemological approach and focused on population-based interventions. This paper makes an earnest appeal that, "Epidemiology must reintegrate into public health and must rediscover the population perspective".

The challenge today is to move beyond all the focus on molecular biology, clinical and vaccine trials, biotechnology, genomic imprinting and stem cells research, to socio-epidemiology, behavioural science research, political economy studies and ethnography so that the research agenda is more balanced and the translation of evidence into policy and action is more comprehensive and evidence-based (Fig. 2).

In many ways, the new socio-epidemiology described more recently has a somewhat similar framework to what this paper describes as traditional epidemiology, except for the fact that the new determinants are not only social, economic, political and cultural but also structural – in society rather than in populations and individuals.

Fig. 2: Developing a research and advocacy agenda for primary health care

A plea for balance

• Molecular biology	• Socio-epidemiology
• Clinical trials	• KAP studies
• Vaccine trials	• Policy studies
• Immunology	• Behavioural sciences research
• Biotechnology	• Political economy studies
• Genomic imprinting	• Participatory research
• Stem cell research	

Recognizing the new paradigm

Many recent documents at the global level are beginning to recognize both the limitations of the current dominant epidemiology and also exploring some of the complexity of public health systems and policies, including the challenges of revitalizing PHC.

The World Health Report 2008 has again placed primary health care on the global agenda. It has very strongly brought into public health thinking the issues of social justice, right to health, participation and solidarity *(17)*. This report emphasizes that public health researchers and system developers must now focus the evidence on universal coverage, service delivery, public policy and leadership reforms. It also talks about mobilizing organizations, imagination, intelligence and ingenuity for supporting system development. All this requires new research evidence like the epidemiology of social determinants and societal structures.

The Commission on Social Determinants of Health (CSDH) *(18, 19)* also places social determinants of health on the map of epidemiological and public health research. It reiterates that evidence should come from multiple disciplines and multiple methodological traditions. Only with that sort of creative cross-fertilization one can bring rich and diverse evidence base for today's complexity. The report mentions with great clarity that, "Evaluations of social determinants of health interventions require rich qualitative data in order to understand the ways in which context affects the intervention and the reasons for its success or failure". It supports all evidence as important and not just randomized controlled trials (RCTs) and laboratory experiments, and suggests various upstream determinants such as socio-economic context and position, differential exposure, vulnerability, health outcomes and consequences as important issues for study.

The Global Health Watch Report 2008, which is also called the Alternative World Health Report from civil society, on the state of global health, says that people's health is safest in people's hands *(11)*; therefore, the objective is to empower individuals and community with knowledge and skills for achieving good health. Civil society needs to strengthen their efforts with epidemiological evidence.

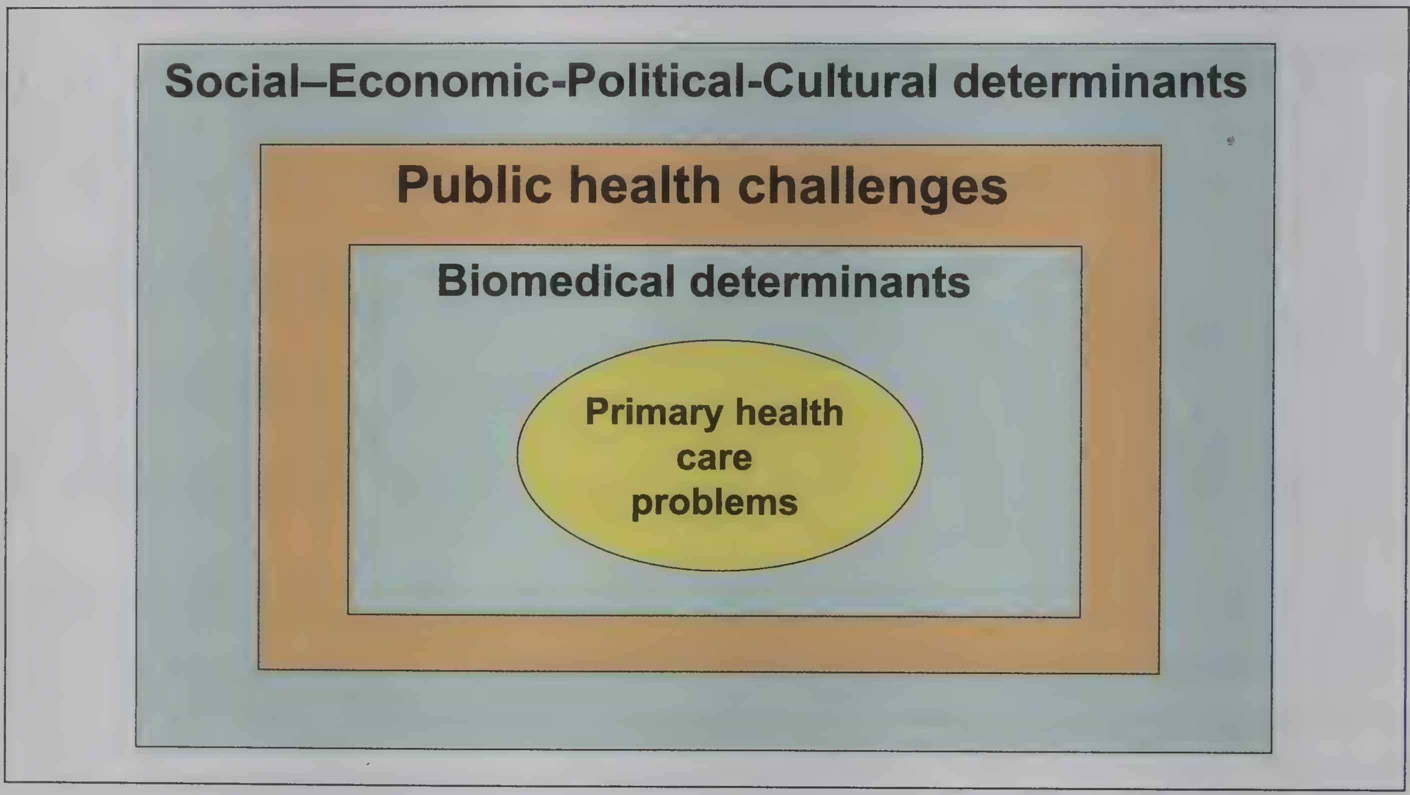
The consensus emerging more recently from a wide range of sources is that:

- there is a need to revitalize primary health care;
- the evidence base should have a much broader focus on upstream determinants;
- new models and paradigms are required, one of which should be to involve communities in evidence-gathering and system development.

Building the new epidemiology - step by step

SOCHARA has begun to work step by step to change the focus of epidemiology from biomedical determinism to a broader social analysis. This is necessary to tackle the complexity of health and health care challenges at the primary health care level. In recent years, SOCHARA has tried to create a diagrammatic model that constructs this complexity in concentric circles or boxes to emphasize that this is not clinical versus public health versus social/structural analysis but is actually a complexity that enhances problem-understanding and challenge as the analysis gets broader and more societal. This diagrammatic model (Fig. 3) shows the primary health care model surrounded by the biomedical determinants, then surrounded by the public health factors and challenges, and then further surrounded by the social, political and cultural determinants.

Fig. 3: Towards a new epidemiological analysis for primary health care research



The diagrammatic model can be constructed by identifying through literature review all that is known about a primary health care problem at the three levels – biomedical (clinical and pathological); public health; and societal (social, economic, political, cultural determinants).

In diarrhoeal diseases, the public health box focuses on poverty, malnutrition, personal and community hygiene, unsafe water supply and inadequate sanitation, inappropriate feeding and weaning practices, and contaminated food as well as fly/vermin breeding. The broader social determinants include inequality and marginalization, migration and displacement, inaccessible and unaffordable PHC, unethical drug promotion, disasters – natural and man-made - and so on *(20)*. Through this model one can widen the lens to give the larger determinants the same sort of rigour in both quantitative and qualitative evidence-gathering as one does to the immediate causes.

Using this new model, a recent analysis of the vector-borne diseases highlighted problems from animal husbandry, forestry, wildlife, sports, international travel, urbanization, labour migration, inequality, marginalization, new economic policies, unsustainable development, privatization, etc. *(21)*.

These models have been presented in various national and global forums to encourage epidemiologists and researchers to move to a much more social-oriented research. This overall shift in our understanding of primary health care problems and public health challenges is also now represented in a diagrammatic way to encourage a shift in the emphasis in research and action from a biomedical model to a social /community model of health research and system building *(22)* (Table 3).

Table 3: New public health/epidemiology: the paradigm shift

Approach	Biomedical deterministic research	Participatory social/ community research
Focus	Individual	Community
Dimensions	Physical/Pathological	Psychosocial, cultural, economic, . political, ecological
Technology	Drugs/Vaccines	Education and social processes
Type of service	Providing/Dependence-creating /Social marketing	Enabling/Empowering/ Autonomy building
Link with people	Patient as passive beneficiary	Community as active participant
Research	Molecular biology Pharmaco–therapeutics Clinical epidemiology	Socio–epidemiology Social determinants Health systems Social policy

This paradigm shift involves at least six elements:

- A shift in focus from individual to community.
- A shift in dimensions from physical and pathological to broader psychosocial, cultural, economic, political and ecological dimensions.
- A shift in technology from drugs and vaccines to education and social processes.
- A shift in the type of service from social marketing and providing models to enabling, empowering and autonomy-building processes and initiatives.
- A shift in the attitude of people from patients and/or passive beneficiaries to people and communities as active participants.
- A shift in research focus from molecular biology, pharmaco therapeutics and clinical epidemiology to socio-epidemiology, social determinants, health systems and social policy research.

This paradigm shift is just beginning to be recognized in the recent literature. When it takes place, then the quest will move to social vaccines that will begin to tackle some of our key primary health care problems and public health challenges at a much broader level.

There was some concern when many of us recently began to use the concept of ‘social vaccine’ to describe actions against the social determinants of disease. Many public health researchers felt that vaccine was a biomedical terminology and we may inadvertently biomedicalize the action on social determinants. However, it was also felt that it was a good metaphor and that social vaccines would actually protect people from the commodification of health and health care. This will be a new terminology for prevention and promotion and probably excite the imagination of primary health care and public health policy activists and professionals.

The task ahead

There is an urgent policy imperative to make epidemiology relevant to primary health care by an active dialogue between public health professionals and epidemiologists and PHC action initiators and civil society activists. This dialogue would result in a lot of cross-fertilization of ideas and experiences, building on the ongoing micro and macro experiments in our countries. Many interesting new experiments can be initiated.

- Will epidemiologists learn how to measure equity? How to do class and gender analysis?
- Will epidemiologists work with lay people to give them the tools of epidemiology? A lot of work has been done recently in the environmental health movement in India where lay activists are collecting evidence for environmental epidemiology and community action.
- Will epidemiologists work with the National Rural Health Mission and give serious methodological direction to new initiatives, such as community monitoring, social audit and people health watch?

This is the epidemiology of the future and a more definitive answer to the question raised at the beginning of this keynote paper - how can epidemiology help primary health care services.

Conclusion

Epidemiology will help the revival of primary health care if it accepts the following directional changes:

- Moves from medical colleges and research laboratories to community;
- Includes the social, economic, political, cultural and environmental analysis in epidemiological studies;
- Introduces the equity, rights and gender analysis;
- Involves the community not as objects of research or as sources of data but as participants in evidence-gathering;
- Understands evidence of social determinants as evidence for social and public health action.

This is the challenge before public health professionals and epidemiologists today. This is the challenge of the Alma Ata Declaration. And this is the challenge of the Bamako Declaration.

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Plenary 2

Epidemiology: ensuring health security

Chairpersons: *Shiv Lal*
N. Kumara Rai

Session Coordinator: *Chusak Prasittisuk*

Emerging and re-emerging vector-borne diseases in Asia – *Duane Gubler*

The health impact of climate change and the role of epidemiology in the WHO South-East Asia Region – *Jacob Kumaresan*

Emerging and re-emerging vector-borne diseases in Asia

Duane J. Gubler

There has been a dramatic global re-emergence of epidemic vector-borne diseases in the past 30 years. Many of the diseases that were effectively controlled in the middle part of the 20th century have re-emerged and new pathogens have emerged, both of which are causing major epidemics of disease. Most of the newly recognized diseases are caused by zoonotic pathogens. These animal pathogens have probably been infecting people for thousands of years in rural areas, but now have the opportunity to infect more people in urban settings.

The parasitic vector-borne diseases are not as important as some of the others in terms of causing epidemic disease. Malaria is the most important vector-borne disease, but 95 per cent of the global malaria burden is in Africa. Most countries in Asia have done a very good job of controlling malaria, although in some areas there may be local problems. The re-emergence of leishmaniasis in India and African trypanosomiasis in Africa are also important.

Of the bacterial diseases, plague is the most important, with natural foci occurring in Asia, the Americas and Africa. However, most of the human plague reported in the last 15 years has come from Africa. The enzootic sites in Asia include China, Viet Nam, Indonesia and India. The 1994 plague epidemic in Surat, India, illustrated the importance of this disease, being the first infectious disease epidemic impacted by globalization. It was a surprise epidemic at the time because for 28 years there were no reported human plague cases in India; the last human case had occurred in 1966. Unfortunately, both the clinical and laboratory diagnoses were confused, causing lack of confidence in the public health system. When pneumonic plague cases were finally reported, it created panic, and resulted in a mass exodus from the city of Surat. Within days, there were reports of cases of plague in other Indian cities, from which people were flying around the world. The international health regulations were implemented, and a number of airlines stopped flying to and from India. The global airline industry, for the first time in history, was partially shut down for about two weeks. The actual outbreak was relatively small, with less than 50 cases, and as a result it should have been a relatively unimportant, local public health event. Instead, it became a media event, an epidemic of panic that turned into a global public health emergency, causing an estimated US$3 billion economic loss to the economy of India. On a global scale, the loss was about US$6 billion. In today's money that does not seem to be too much, but in 1994 that was a lot of money. This epidemic was a wake-up call because, for the first time in modern history, it was realized that epidemic infectious diseases could move very rapidly via modern transportation. This was reinforced by the severe acute respiratory syndrome (SARS) epidemic nine years later.

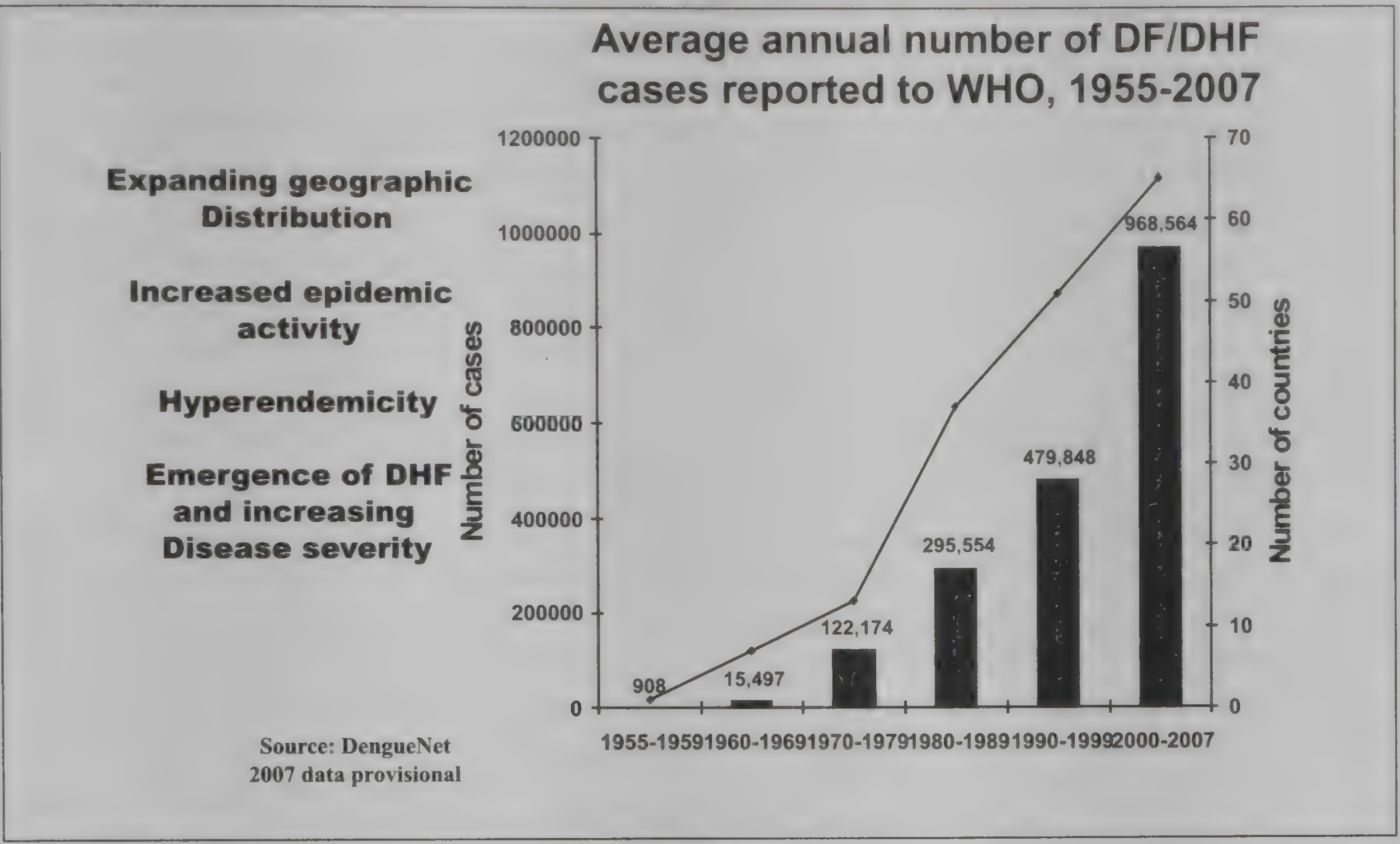
Epidemics of louse-borne typhus and louse-borne relapsing fever have occurred in Africa, diseases that had not been seen since World War II. In the temperate zones, lyme disease has become an important emergent disease.

Epidemic vector-borne viral diseases have been among the most important emerging infectious diseases on a global scale. In 2010, there are very few places in the world where one can go without being at a risk of infection with an arbovirus of one kind or the other (Fig. 1). In Asia, there are already numerous known arboviral diseases, but it is likely that there are many more that are as yet unknown. Dengue haemorrhagic fever, Japanese encephalitis and chikungunya are the major arboviral diseases in Asia, but others that have occurred, such as Zika, Kyasanur Forest Disease, Crimean Congo Haemorrhagic Fever and Chandipura Encephalitis, are more of a local problem.

Fig. 1: Global prevalence of viral vector borne diseases

Urban dengue has caused major epidemics in Asia for over 200 years; rural dengue for much longer. One of the first epidemics of a dengue-like disease occurred in Jakarta in 1779. After World War II, dengue was controlled for a number of years as a result of the malaria eradication programme and the widespread use of DDT. With the economic development and urbanization of south-east Asia in the 1950s and 1960s, epidemic dengue haemorrhagic fever emerged. This disease was localized in a few south-east Asian countries for 20 years, but in the 1970s, it started expanding its geographical distribution in Asia and then spread to the Pacific and the Americas. Since 1980, it has spread to nearly 100 countries (Fig. 2). In the last 30 years, a dramatic global expansion has occurred in the geographical distribution of both the mosquito vectors and the viruses. This has led to an increased epidemic activity in most tropical areas of the world. That, in turn, has led to hyperendemicity, i.e .the co-circulation of multiple virus serotypes in the community. It is hyperendemicity that is most frequently associated with the emergence of dengue haemorrhagic fever in a particular country.

Fig. 2: Average annual number of dengue cases reported to WHO, 1955-2007



Japanese encephalitis is strictly an Asian disease and is the most important cause of encephalitis in children in Asia, with an estimated 50 000 cases and 10 000 deaths every year. This disease also began moving in the 1970s into Nepal, western India and then into Pakistan. It also spread into the Pacific, the Philippines, Malaysia, Papua New Guinea and Australia (Fig. 3). The disease is fairly well controlled in those countries that historically had high incidence, i.e. China, Japan, Korea and Taiwan, China, through the use of an effective vaccine.

Fig. 3: Spread of Japanese Encephalitis (1978-2010)

Chikungunya, an African virus, has been found in Asia for many years. It was introduced into Asia some time in the 1950s or '60s. Some of the first epidemics of a haemorrhagic disease reported in Kolkata in the 1960s turned out to be associated with chikungunya. The virus then spread to a number of south-east Asian countries. Epidemics occurred in the 1970s in Myanmar, Thailand and Indonesia. The virus was distributed widely in the 1980s but it was not reported for many years. Periodically, small focal outbreaks occurred, mainly in Indonesia, but it was not a major epidemic disease. That changed in 2004 with the emergence of a new virus subtype in Kenya, which subsequently spread over the next couple of years to islands off the East African coast, causing major epidemics. It was introduced into India some time in 2005 or 2006 and has caused major epidemics throughout south-east Asia in the last four to five years. It was introduced into Italy in 2007 and caused a small outbreak of about 250 cases. An important question is how this virus was maintained in Asia for over three decades? Interestingly, chikungunya virus was recently documented in a non-human primate in Malaysia, suggesting that there is a non-human primate reservoir similar to dengue, i.e. a zoonotic cycle.

There are many factors contributing to the dramatic re-emergence of vector-borne diseases over the past 30 years. However, the major drivers of this global emergence are 3-fold: 1) demographic changes; 2) modern transportation; and 3) lack of effective public health infrastructure. Population growth and its movement have been the major drivers of environmental change, and one of the most important environmental changes that has contributed to the increase in epidemic infectious diseases, especially vector-borne diseases, is uncontrolled urbanization. Agricultural and land-use changes such as deforestation have also contributed. Population growth has been the major driver of changes in animal husbandry, which has contributed to a number of major epidemics. The jet airplane has increasingly become the principal mode of transportation over the last 40 years. As a result, there has been a dramatic increase in the movement of people, animals and commodities during this time, providing the mechanism to move vectors and pathogens around the world. When pathogens move into areas where there is little or no vector control, there is an increased probability of secondary transmission, and thus occurrence of epidemics.

The number of people living in urban areas of the world has also shown a dramatic increase. In 2007, the world crossed the 50% line with over half of the world's population now living in urban areas. Most of this growth has been due to migration from rural to urban areas. People who move into cities bring their rural lifestyles and pathogens with them. The United Nations has defined urban agglomerations as cities with five million people or more. In 1950, there were only eight such cities in the world; by 2000, there were 40 such cities. Most of the new cities were in the Asian region. As projected over the next five to ten years, another 20 cities will be in this category, and most of these cities are projected to be in the Asian region. The United Nations thus projects that most of the urban growth in the world is going to occur in Asian cities. This creates poor living conditions for the people, especially crowding and lack of basic services, i.e. housing, piped water, sewage, waste management, etc. Poor urban slums create ideal conditions for increased transmission of all kinds of infectious diseases pathogens, especially the urban mosquito-borne diseases. Combine this to the fact that all of these urban centres have modern airports through which tens of millions of people travel every year, creating an ideal mechanism for increased movement of pathogens. Every year, over two billion people get on the air and fly somewhere. Many of these people carry pathogens with them. Dengue is a good example to illustrate this phenomenon. In 1970, only south-east Asia had hyperendemicity of dengue with all four virus serotypes co-circulating in most countries. It was in this setting that dengue haemorrhagic fever emerged. The African and American tropical countries were either non-endemic with no viruses or hypoendemic with a single virus serotype circulating. In 2010, however, the whole of the tropical world is hyperendemic (Fig. 4A & 4B). And this increased transmission has led to the emergence of epidemic dengue haemorrhagic fever in many countries of Asia and the Americas. And it is not just dengue; a lot of other viral, bacterial and parasitic pathogens have taken advantage of easy transportation around the world.

Fig. 4a: Global distribution of dengue virus serotypes, 1970

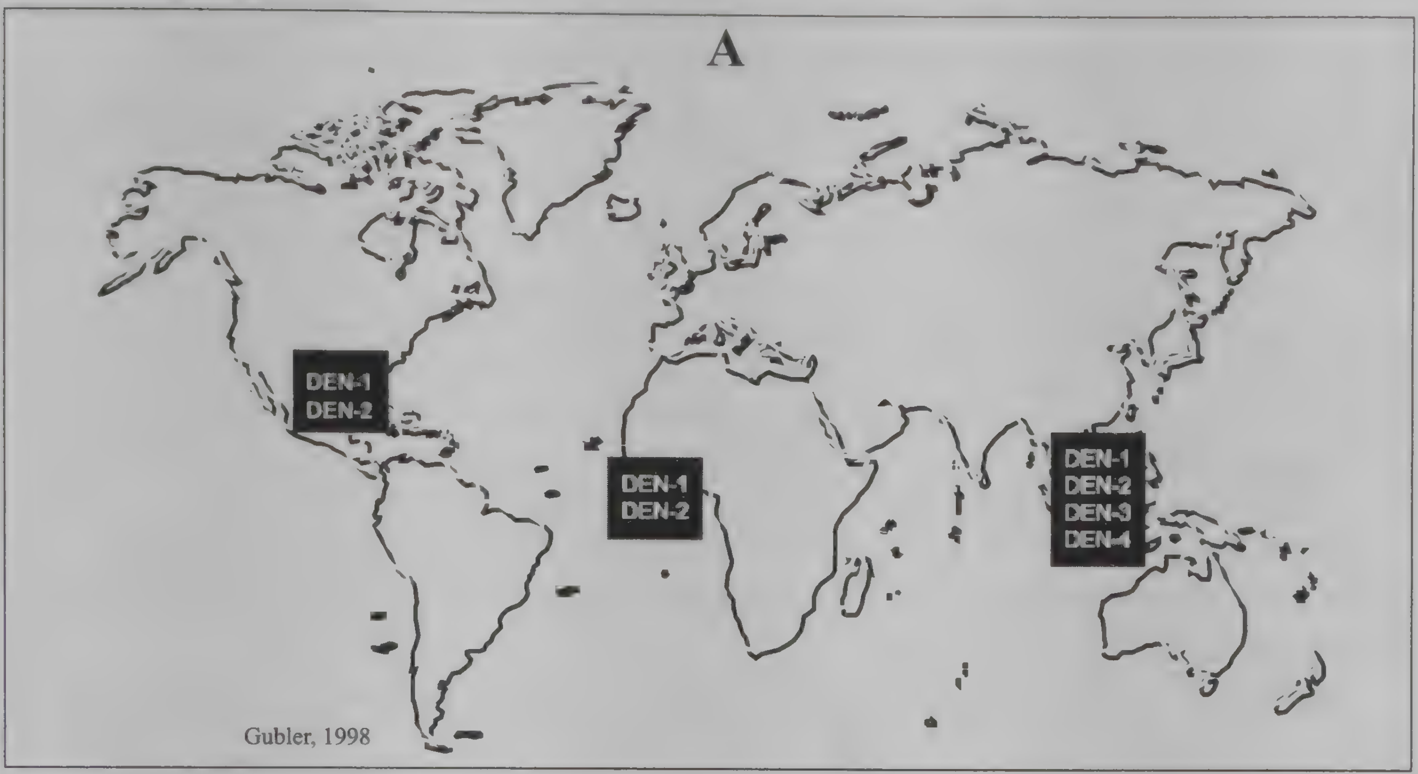
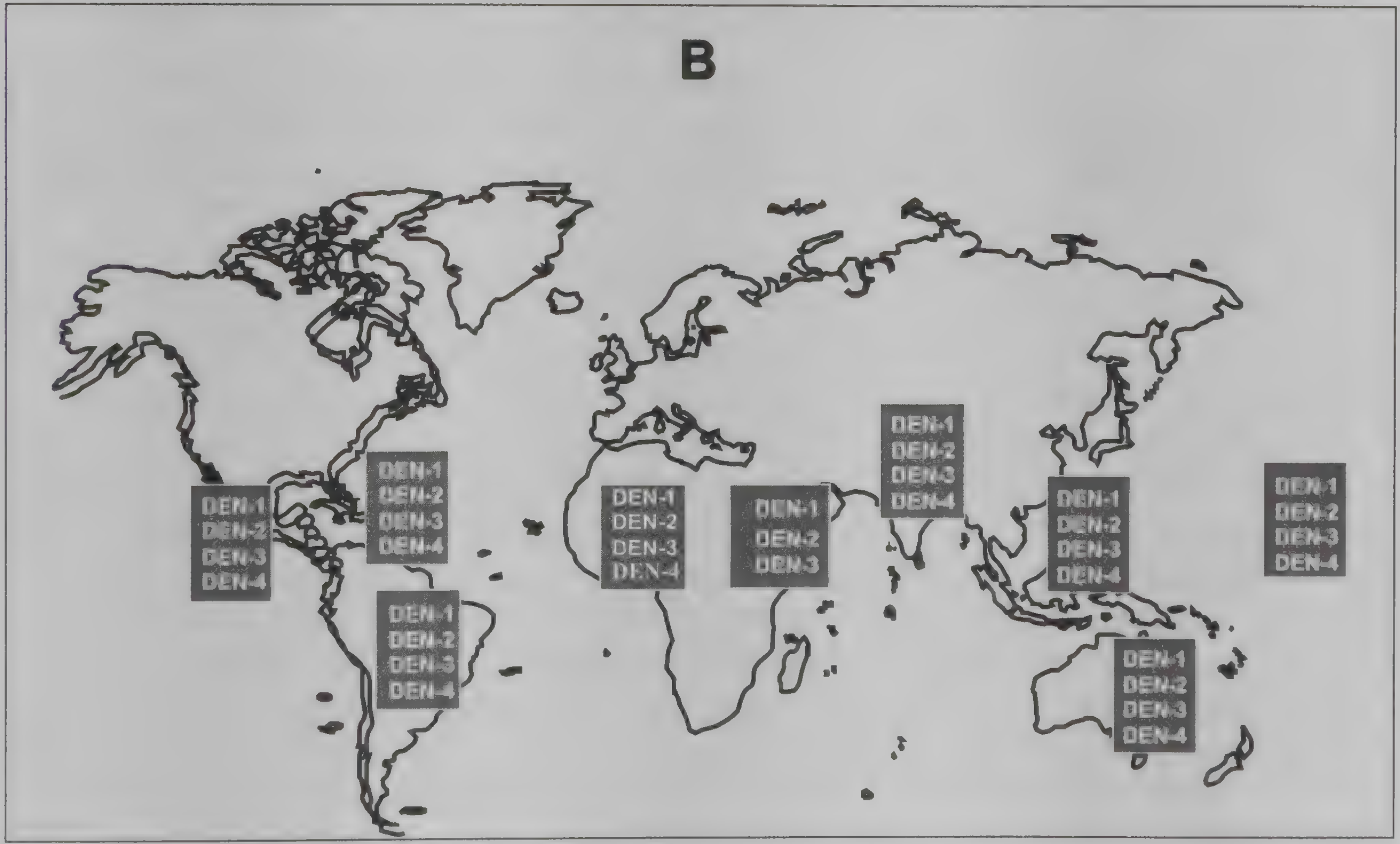


Fig. 4b: Global distribution of dengue virus serotypes, 2010



Yellow fever, which used to be the scourge of the Western hemisphere, is also transmitted in the urban environment by *Aedes aegypti* mosquitoes. It has an urban cycle that is identical to the dengue and chikungunya viruses. It should be noted that epidemic yellow fever and dengue were effectively controlled in the American tropics in the 1950s and '60s. The Pan American Health Organization had implemented a region-wide *Ae. aegypti* control programme, which led to the elimination of this species from much of the Central and South America. The programme was so successful in preventing epidemic yellow fever and dengue that public health departments disbanded the eradication programme

in the early 1970s because it was no longer considered financially justified. *Aedes aegypti* has since re-invaded most of those countries, and this, along with urbanization, is responsible for the dramatic increase in epidemic dengue in the region.

Yellow fever is still maintained in the Amazon basin in a sylvatic cycle involving monkeys and *Haemagogus* mosquitoes. Many cities in the Amazon basin have become highly urbanized over the past 30 years, with human populations of more than one million people in each, and all have been re-infested by *Ae. aegypti*. The concern is that urban epidemics of yellow fever will emerge in South America. There have already been a few instances of sporadic urban transmission of yellow fever in some of the cities. This virus, just like dengue, travels in people. If urban yellow fever epidemics begin in South America, the disease will spread in people via modern transportation very quickly around the world. A major concern is the Asia-Pacific region, where approximately two billion susceptible people live in areas at risk for yellow fever. What is not known is whether it would actually cause epidemics in Asia. If this scenario occurs, however, it would create a global public health emergency regardless of whether there is secondary transmission. It should be noted that there is a very effective vaccine for yellow fever, but, unfortunately, there are not enough doses available in the world for Latin America, let alone Asia.

Diseases have been spread geographically with trade throughout the history of man. But the 21st century is a completely new situation, with an integrated global economic system with a transnational flow of knowledge, capital, products, people, animals, and pathogens. Modern transportation can result in the rapid spread of epidemic infectious diseases from the point of origin, as illustrated first by the plague, and then the SARS epidemics. Fortunately, plague did not spread out of India, but the potential for rapid spread was underscored by SARS in 2003.

In summary, it is demographic changes that are driving environmental change, which then drives changes in species' evolutionary dynamics, both in the natural and the human ecosystems, thus increasing host-vector-parasite interactions. The result is increased frequency in the emergence of epidemic exotic diseases.

To reverse these trends, urgent action needs to be taken to prevent or minimize the movement of pathogens and vectors by modern transportation. Currently, there is no international public health agency that is addressing this problem. Effective laboratory-based surveillance is lacking. Very few countries in the world have adequate surveillance to monitor the known pathogens, let alone the exotic ones, as they move around the world. Public health infrastructure, which has been allowed to deteriorate over the past 50 years, needs to be strengthened. There is a need for more and better-trained personnel, laboratory and epidemiology capacity, and better tools including vaccines, drugs and insecticides. There is also a need to understand the disease ecology as most of the pathogens that emerge are not going to have a vaccine or a drug. Political will is critical to make the policy changes necessary for the economic support to implement programmes to stop the spread of vector-borne diseases. Finally, control programmes must be regional, as individual countries cannot control these diseases alone. The greatest threat to public health and economic security over the next few years will most likely be epidemic infectious diseases that are transmitted by the respiratory route or by mosquito vectors.

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The health impact of climate change and the role of epidemiology in the WHO South-East Asia Region

J.A. Kumaresan, J.M. Lapitan and G. Sanchez Martinez

Over the last century, and particularly in the last few decades, human activities like the burning of fossil fuels, deforestation and changes in land use have released large quantities of carbon dioxide and other greenhouse gases, trapping an excess of heat in the lower atmosphere. The resulting changes in the global and regional climatic patterns may result in significant risks to health – from mortality and disorders due to extreme weather to changing patterns of infectious diseases – as reported in 2007 by the Intergovernmental Panel on Climate Change (IPCC) *(1)*. Furthermore, climate change may influence causal pathways between a wide range of exposures and health outcomes, thus effectively becoming a multiplier of health risks.

The poorest countries are likely to be disproportionately affected by climate change and its impact on health due to their inadequate public health infrastructure, poor disease surveillance, weak health systems, lack of human and financial resources and inadequate emergency preparedness and management systems. High population density may compound people's vulnerability to climate change due to poverty, further increasing the burden of disease on the most disadvantaged countries and regions. The WHO South-East Asia Region (SEAR), comprising 11 countries, is home to 26% of the world's population *(2)* and 30% of the world's poor *(3)*. Because of this combination of factors, the consequences of climate change could be disastrous for the Region.

The magnitude of direct climate-related impact in the Region is already staggering. Weather extremes – such as heavy rains, floods with consequent landslides and storm surges – from 1998 to 2009 alone accounted for more than 750 000 deaths or 61.6% of the world's total deaths secondary to disasters from all natural causes *(4)*.

The rising sea levels – another likely outcome of global warming – increase the risk of coastal flooding. The Asian Development Bank (ADB) predicts that sea levels could rise as much as 40 centimetres by the end of this century, which could endanger populations living along the coastlines *(5)*. Floods (whether coastal or inland) can directly cause injury and death, population displacement and increased risk of infection from water and vector-borne diseases. Geographically-vulnerable populations living in densely populated coastal areas, such as urban centres along the Region's river deltas, are especially prone to climate-induced disasters, as shown by the devastating floods in Bihar, India, in 2009, and recurrent flooding in various areas of Bangladesh.

Abnormally high ambient temperatures, which are projected to grow in frequency over most land areas, may lead to increased deaths from heart and respiratory diseases, particularly in cities. Pollen and other aero-allergen levels, which can trigger asthma, are also higher in extreme heat. Air pollutants, whose effects are synergistic to those of heat, are also projected to worsen under most climate-change scenarios. Increasing temperatures and more variable rainfalls are expected to reduce crop yields in many areas throughout the Region, where food security is a problem. Malnutrition causes millions of

deaths each year, from both a lack of sufficient nutrients to sustain life and the resulting vulnerability to infectious diseases such as malaria, diarrhoea and respiratory illnesses. Famine-induced population displacements could, in turn, increase tensions and risks of conflict.

Most importantly, of the 14 million deaths that occur in the Region annually, 40% are attributable to communicable diseases *(6)*. Increased average temperatures could prolong peak periods for vector-borne diseases, and extreme weather events can create ideal conditions for the spread of vector-borne and diarrhoeal diseases such as cholera. Malaria remains a major health problem in the Region where 77% of the population is at risk and the annual malaria incidence was in the range of 2.16 million to 2.83 million cases during 2000-2008 *(7)*. In much of the Region, dengue is spreading not only geographically but also in explosive outbreaks. It has been reported even in the mountainous countries of Bhutan and Nepal since 2002. Chikungunya resurfaced in India after 31 years in 2006 *(8)*. In addition to an already highly complex situation of communicable diseases, conditions conducive to a further spread of vector-borne diseases are projected under most climate scenarios.

Role of epidemiology in climate change mitigation and adaptation for health

Existing and emerging evidence of climate-related health impacts is built mainly through and derived from long-standing epidemiological surveillance systems, registries and databases. Most projections of health trends relating to changing climatic and environmental influences rely on existing epidemiological studies and reports that look at the relationships between the variables of interest and differential effects of climate parameters. For instance, recent WHO-funded studies in Kolkata (India) *(9)* and Jhapa (Nepal) *(10)* confirmed significant associations between temperature, rainfall and the incidence of vector-borne and diarrhoeal diseases. Furthermore, positive trends for cholera were observed in Kolkata correlating to increases in the number of hotter and rainy days in the last decade. These data, however, need be interpreted cautiously due to the multitude of influences and confounding variables in the causal pathways of diarrhoeal diseases. The replicability of these studies is limited by the paucity of data, their quality and difficulties in their comparability with older databases and registries. Data collection, therefore, needs to be supported and extended prospectively in time.

Epidemiologists can play a key role in informing and assessing strategies to cope with 'unavoidable' (i.e. beyond the realm of health sector) impacts brought about by climate change at all levels. Adaptation in the health sector can be best achieved through multisectoral action within a broad framework firmly rooted in the social determinants of health approach. Adaptation to climate change will work best when the affected populations are actively engaged in the process. Communities that cannot adapt are more susceptible to suffering from weather and climate impacts *(11)*. City stakeholders need to appreciate the implications of relocation of housing to areas at risk of flooding and the crucial importance of water-sanitation-hygiene improvement in the wake of additional climate-related impacts. Public health researchers can provide support through health impact assessments of planned interventions as well as ascertainment of epidemiological impacts of sectoral policies (e.g. in transport, energy, housing).

Epidemiology can also help promote actions that reduce greenhouse gas emissions at various levels by estimating health benefits from interventions, plans, programmes and regulations that lower the use of polluting fossil fuels, promote energy efficiency or use of renewable energy sources, improve traffic flow, foster non-motorized transport and improve air quality. For example, promoting the safe use of public transport and physical activity - such as biking or walking as alternatives to using private vehicles - could reduce carbon dioxide emissions and simultaneously improve public health. The collective impact of these 'co-benefits' provides the basis to promote actions with social, environmental and health gains in the context of limited resources and competing priorities.

The way forward

Epidemiological research and practice can strengthen and inform efforts in the struggle against climate change. The ascertainment of baseline relations between climatic conditions and health outcomes *(12)* can crucially support efforts towards strengthening health systems and improving preparedness and response capacities. There is a need for appropriate methods to conceptualize the full chain of events leading to potential health effects.

Most areas still need to build a solid base of retrospective studies assessing the relationship between past climate variability and selected infectious, diarrhoeal and vector-borne diseases. Retrospective evidence can provide the basis for conducting prospective studies that may give better control over data collection and confounders, thus enhancing ability to assess the differential effect of changes in climate over time. It is also necessary to increase the number of studies to establish appropriate risk thresholds for recurring events such as floods and heatwaves and to develop early warning systems. The identification of risk factors for climate-sensitive diseases is another key input to be derived from epidemiological research and practice so that vulnerable groups are identified and interventions targeted. These interventions can be monitored and evaluated through result-based measurement of achieved reductions in incidence and/or mortality.

Strategies and plans for adaptation to climate change should systematically draw on epidemiological data to strengthen evidence base and overall validity. The supporting role of epidemiology in policy and decision-making regarding climate change must also extend to greenhouse gas emissions' mitigation. Health-risk and health-impact assessments must be included in the evaluation of the effects and benefits of carbon-cutting interventions.

In summary, the role of epidemiological research is critical for a better understanding of the health impacts of climate change. Such knowledge must be applied to strengthen health systems and to trigger adaptation measures. It can also provide an evidence base of health benefits to support policies that can reduce greenhouse gas emissions.

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Plenary 3

Research to policy: walking on a bumpy road

Chairpersons: *V.M. Katoch*
Tee Ah Sian

Session Coordinator: *Amaya Maw Naing*

Translating data to information for policy formulation and implementation: Experience from SARS outbreak – *Hitoshi Oshitani*

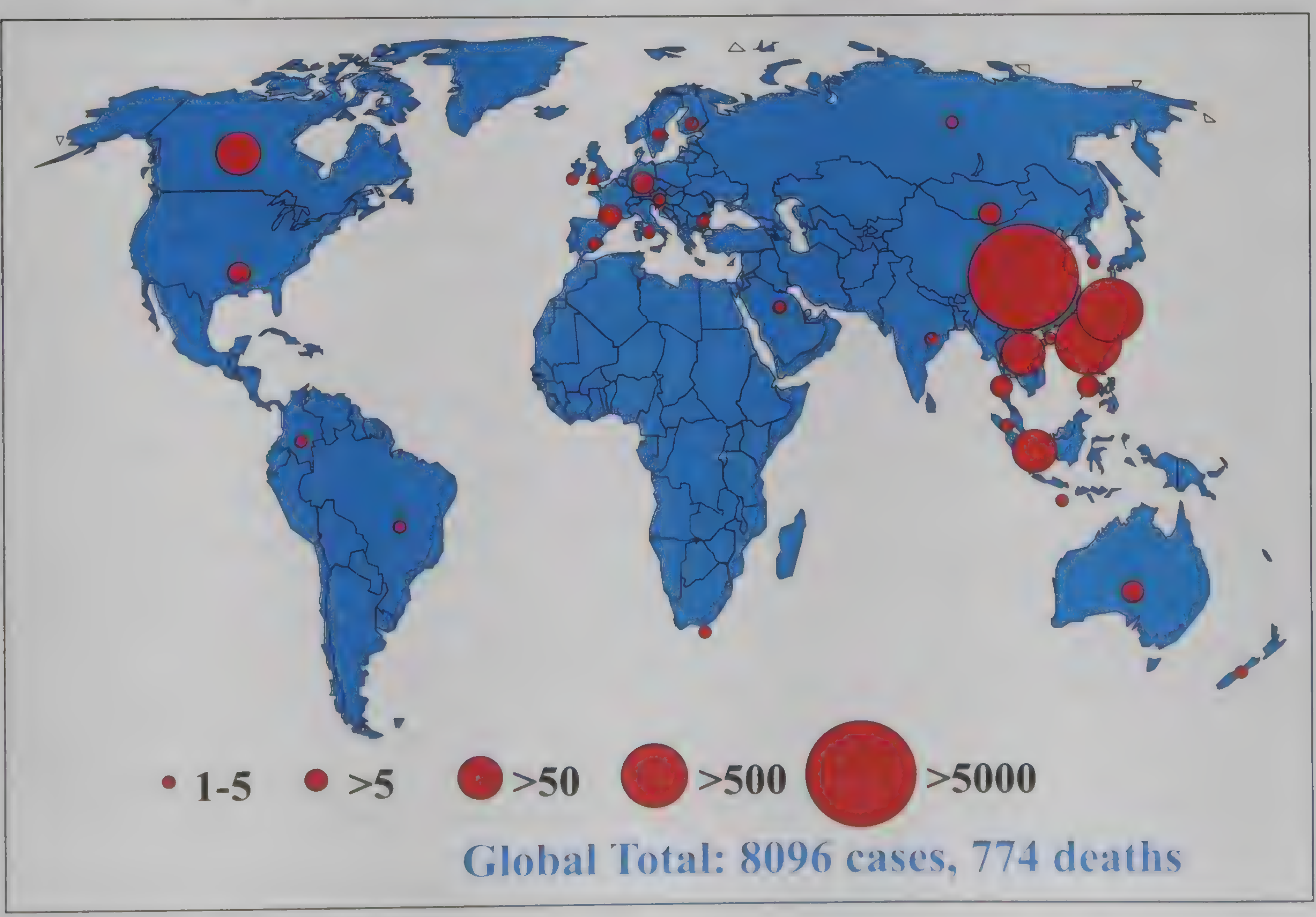
Research and policy interface – *Ulysses Panisset*

Translating data into information for policy formulation and implementation: experience from SARS outbreak

Hitoshi Oshitani

In the past few years, significant outbreaks of emerging diseases, including that of severe acute respiratory syndrome (SARS) in 2003, have occurred in south-east Asia. SARS is believed to have originated in the Guangdong province, China *(1)*. The first identified case occurred on 16 November 2002. After the explosive outbreak in Guangdong, the disease spread to nearly 30 countries around the world. Most of the cases of SARS occurred in Asia. Globally, 8096 cases were reported to WHO with 774 deaths (Fig. 1). By early March 2003, SARS was thought to have spread to several countries; hence, WHO issued a global alert on 12 March 2003 *(2)*. SARS was successfully contained not because of vaccines or antiviral drugs but because of the conventional control measures such as contact tracing, quarantine and isolation. Epidemiology had a central role in SARS containment; therefore, SARS is one of the success stories of epidemiology.

Fig. 1: Cumulative Number of Probable Cases of SARS 1 Nov 2002 – 7 Aug 2003



The Prince of Wales Hospital in Hong Kong reported more than 100 cases of SARS *(3)* among its health care workers. An outbreak also occurred in the French Hospital, Hanoi, Viet Nam, which reported more than 20 cases, again mostly among its health care workers*(4)*. The index case in the Hanoi hospital had visited Hong Kong. At that time the causative agent of SARS was not known; whether this disease was caused by a virus or bacteria was also not known. It was also not known whether there was any link between the three outbreaks, i.e. Guangdong, Hong Kong and Hanoi. Effective control measures and treatment were also not available at that time. After WHO issued the global alert, cases from Singapore were reported to WHO on 13 March 2003, and an outbreak in Toronto, Canada, was reported on 14 March. Based on information from these countries, WHO issued the first travel advisory and case definition on 15 March 2003.

Initially, it was not known if there was any link between these outbreaks. Whether there was a common source for all the outbreaks was an important question because if it was so, then similar outbreaks could be expected in many different places in the next few days. Since the causative agent was not known, diagnostic confirmation was not available at that time. The identification of the epidemiological link was the only way to identify the common source of the outbreaks. Hence, a multicountry epidemiological investigation was launched. The common source for the various outbreaks was found to be a hotel in Hong Kong *(5)* where the affected persons in Hanoi, Toronto and Singapore had stayed. The index case had stayed in Room 911 on 23 February and that was the source of infection for most of the other cases.

After WHO developed a case definition, a number of epidemiological studies were carried out in different places. Many important epidemiological findings, including the infectivity of SARS, were found during the course of the investigations. SARS had an incubation period of two to ten days. The patient did not have any or a very little infectivity in the early stage of illness. Only those with a very severe pneumonia had infectivity. That was the key information to develop a control strategy for SARS. Extensive epidemiological investigations in different places also found that most of the infected persons did not spread the virus to anybody else but there were some people who did spread the virus to many people (Fig. 2). This is called a ‘super-spreader event’. There were a few such events which triggered an outbreak in different places. In most of the places, the outbreak started as a nosocomial infection and many health care workers were infected in the process.

The containment strategy for SARS relied on the fact that the infected patients were infectious only when seriously ill; only a few super-spreading events were associated with many secondary cases. That is why isolation and quarantine was very effective for SARS disease control. The contact tracing identified most of the close contacts and chain of transmission. Infection in hospital was the key to transmission. Implementation of strict infection control measures was effective for the prevention of transmission to the community. All close contacts were put in quarantine. If there was any case among the close contacts, the affected person was kept in isolation in a hospital where infection control measures were implemented. These strategies led to the containment of SARS (Fig. 3).

Another important aspect of the SARS outbreak was the multicountry collaboration in epidemiological investigation. SARS was one of the most significant events that required such investigation. On 15 March 2003, the flight CA112, from Hong Kong SAR to Beijing, caused the infection of at least 22 cases among the passengers. They were from different places like Taiwan (China), Hong Kong (China) and Singapore (Fig. 4). Extensive multicountry investigations identified all possible cases who had travelled in that flight *(6)*. Epidemiological investigation of the hotel in Hong Kong and flight CA112 involved many countries. These investigations were based on the network of epidemiologists and health officials in concerned countries, which was coordinated by WHO.

Fig. 2: Transmission of SARS in Singapore

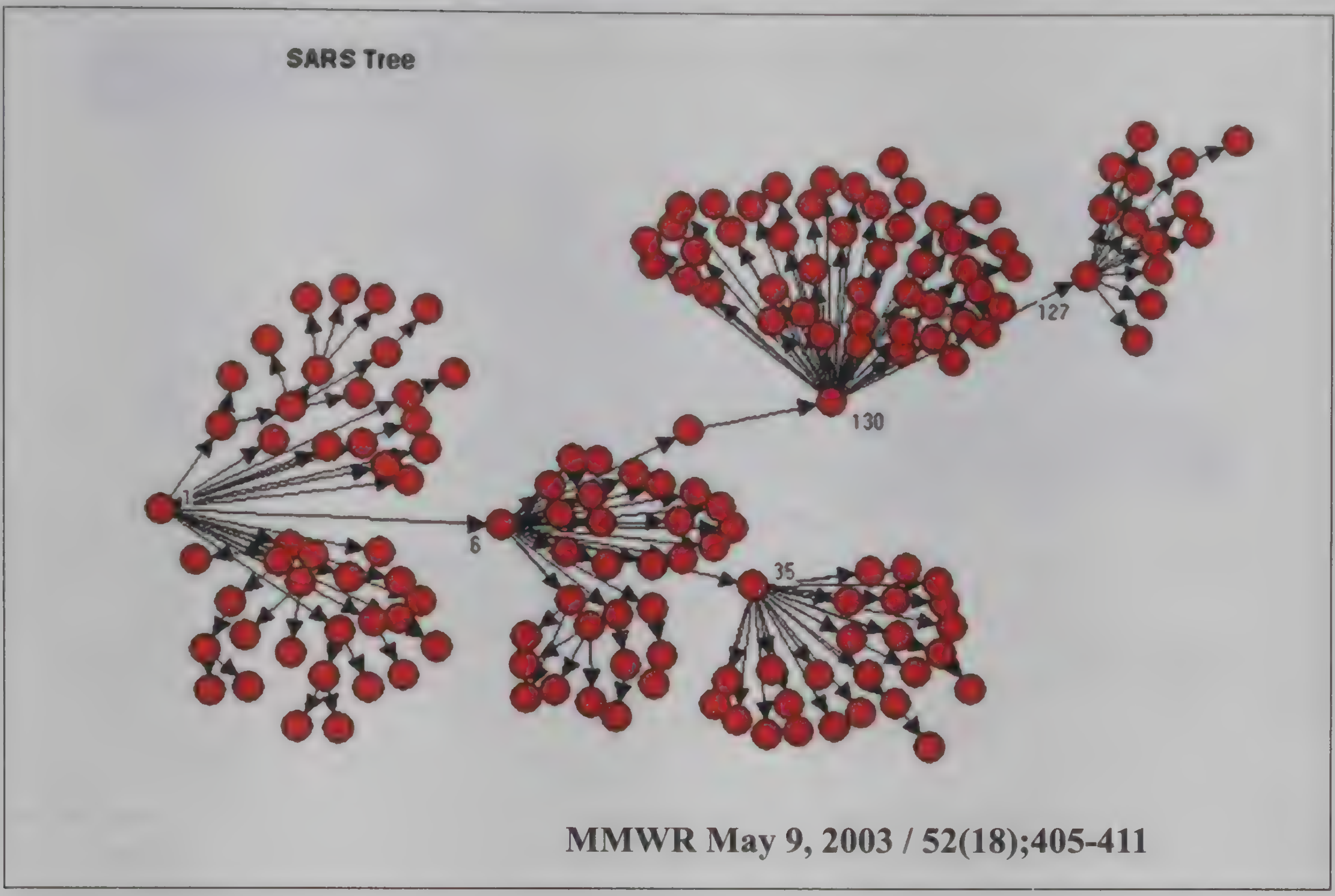


Fig. 3: Containment Strategy for SARS

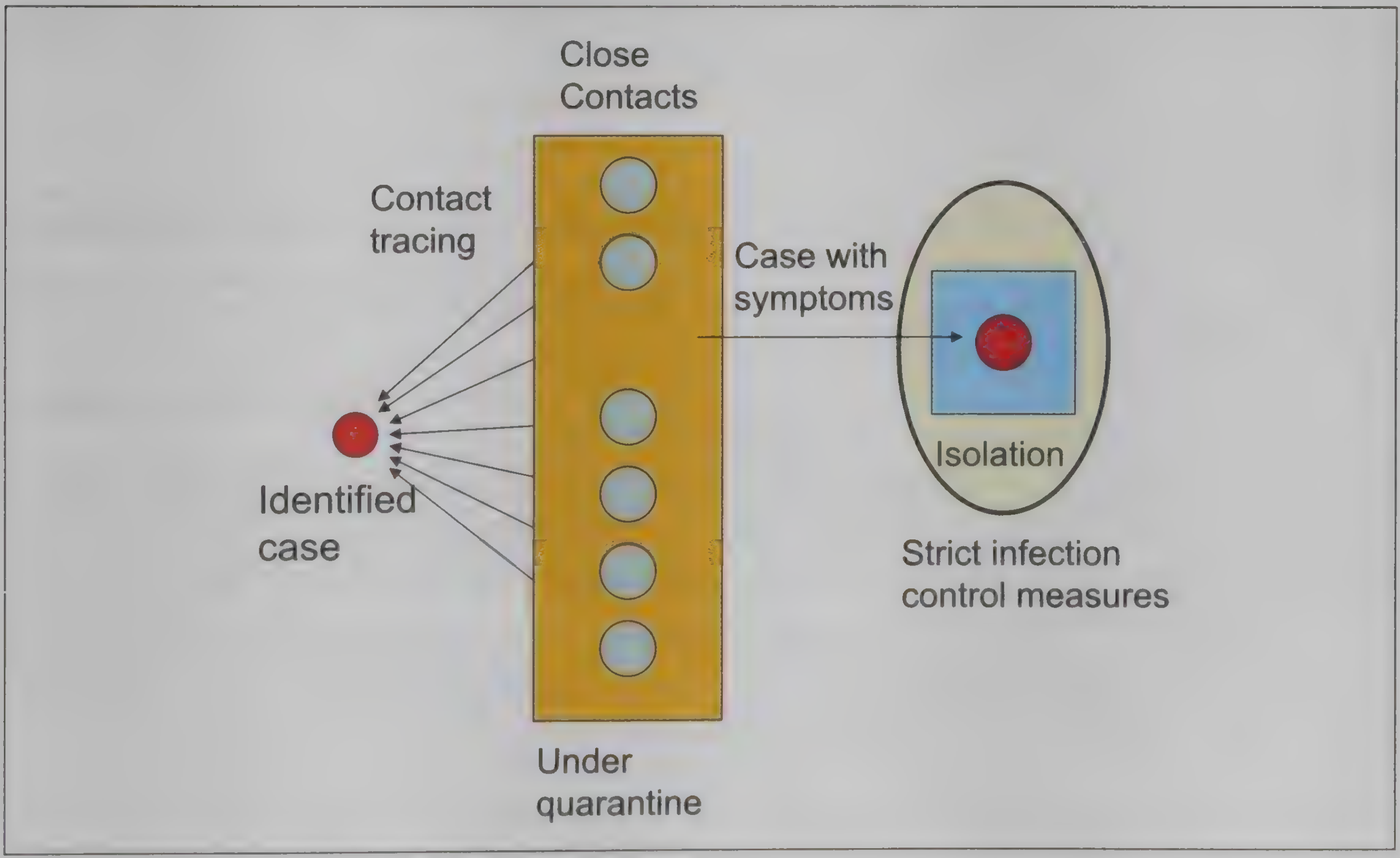
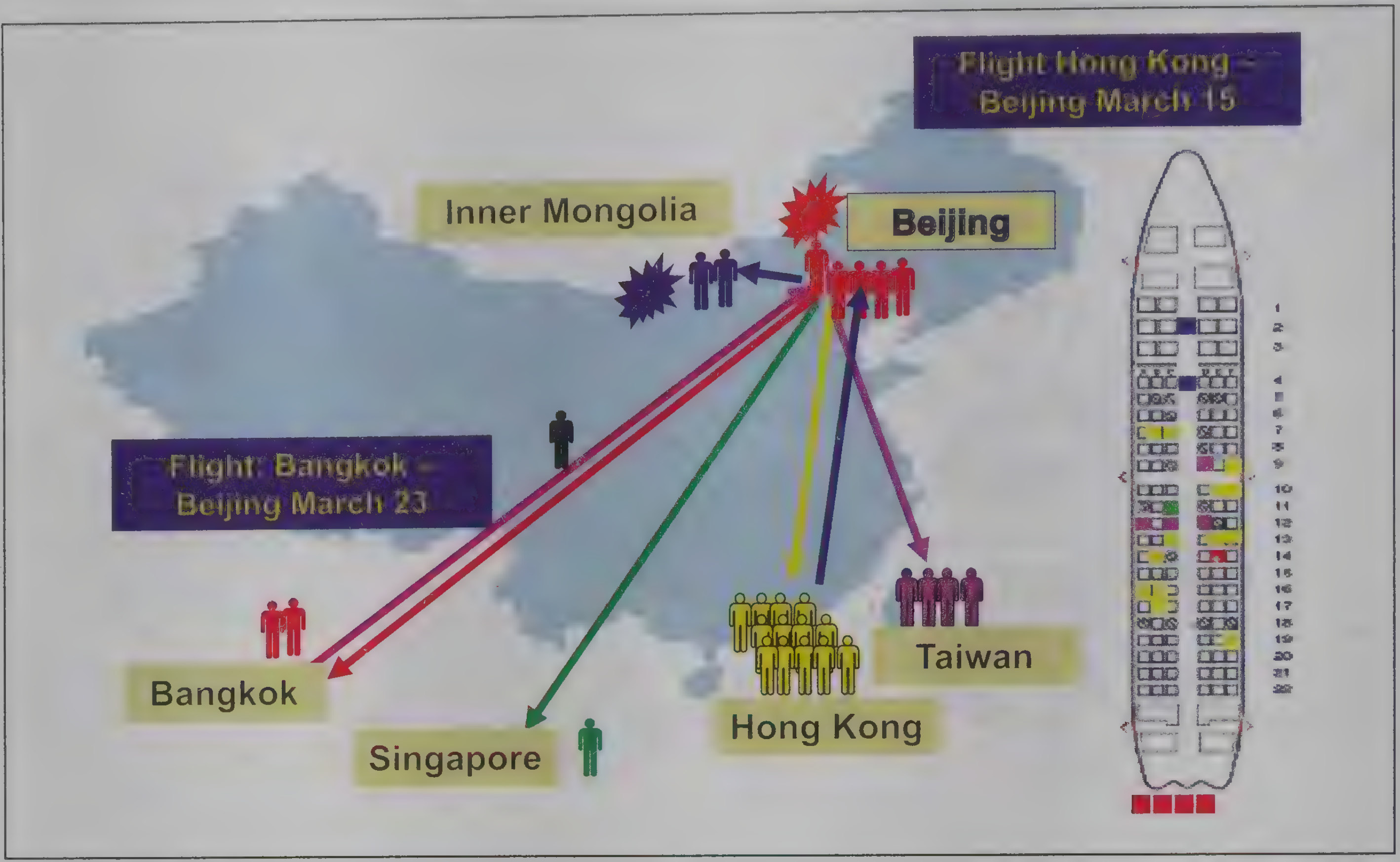


Fig. 4: Flight-Associated Transmission



Thus, SARS could be successfully contained. WHO declared the global containment on 5 July 2003. Epidemiological data provided the necessary information to develop effective policies for control. Extensive epidemiological investigations identified most of the infected people and their close contacts. The multicountry investigations helped to arrest the cross-border transmission of SARS, which is one of the success stories of epidemiology.

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Research and policy interface

Ulysses Panisset

Policy-making in public health can be a risky undertaking as health policies developed and implemented by ministries of health in low- and middle-income countries affect large populations. As such, policies based on sound scientific evidence and best practices may diminish the potential of harm and help achieve significant health outcomes *(1)*. Several studies have shown that a systematic use of high-quality scientific evidence in policy-making helps ensure efficient use of the extremely scarce resources in a context in which every investment available for policy implementation must be effective and safe and a promoter of health equity.

The state of health systems in many countries is not on track to reach the Millennium Development Goals (MDGs) on health without significantly increased efforts. Available knowledge to improve health systems and their services to populations is not reaching those countries which need it most *(2)*. If current trends persist, large numbers of people will continue to die unnecessarily from pregnancy, childbirth and childhood illnesses.

In countries that are home to the majority of the world population, six preventable diseases account for more than 70% of 10.6 million annual deaths of children under the age of five years. Every year, more than half a million women in low- and middle-income countries die in pregnancy and childbirth. An evaluation of the latest data and progress related to health toward the MDGs reiterates that improved decision-making, which would lead to universal access to broad-based, improved health services, could save several million children's and mothers' lives each year with measures that are evidence-based, relatively inexpensive and efficient *(3)*. Furthermore, health policies demand integration with scientific evidence addressing other sectors as well. Health goals cannot be seen in isolation; reducing poverty and increasing education and gender equality are tied to good health, better nutrition and clean water *(4)*.

Both policy-makers and researchers who attended the 2010 WHO/SEAR Conference on Epidemiology will agree that the elimination of neglected diseases in South-East Asia requires "strong and sustained political commitment and policies based on evidence" *(5)*. The use of evidence to inform health policies, however, is not an easy task. It requires constant collaboration between policy-makers and researchers as well as mechanisms and methodologies to facilitate the process of translating research results into policies.

However, if researchers and policy-makers share the same goal of improving the health situation of large populations, in practice, they find the process of working together similar to riding a bumpy road, often on its opposite sides. The relationship between researchers and policy-makers has never been an easy one: they adopt different ways to communicate and their agendas, goals and modus operandi are different and often conflicting *(6)*.

How can governments better develop a sustainable interface between research and policy to improve policy-making in public health? A systematic review of studies evaluating policy-makers' perceptions of their use of evidence identified the following as process facilitators: (a) frequent two-way personal contact between researchers and policy-makers; (b) the perception that research must be timely, relevant and of sound quality; and (c) elaboration of summaries with policy recommendations ('policy briefs'). The most commonly identified barriers were: absence of interaction, timeliness, relevance and credibility; lack of translation to the user; and mutual distrust between researchers and policy-makers *(7)*.

Both researchers and policy-makers working on knowledge translation into policy have developed mechanisms and tools to better understand the barriers and promote facilitating factors to produce evidence-informed policies. Thus, knowledge translation to policy can be defined as a research process to promote the use of scientific evidence in policy-making, taking into account multiple factors such as the political context, available resources, existing regulations and legislation, and the practical experience of policy-makers, practitioners and researchers in addressing health problems. Knowledge translation has now evolved from the academic confines of high-income countries to currently achieving successful experiences in low- and middle-income countries.

Over the last few years, there has been a sustained effort at the international level to encourage systematic knowledge translation practices in public health. One landmark effort is the Ministerial Summit on Health Research that WHO promoted in Mexico in 2004. Another landmark is the 2005 World Health Assembly resolution 58.34, which called upon WHO Member States to "establish or strengthen mechanisms to transfer knowledge in support of….evidence-based health-related policies." This prompted WHO and ministries of health in several low- and middle- income countries to launch EVIPNet (Evidence-Informed Policy Network), a programme that encourages policy-makers in low- and middle-income countries to systematically use evidence generated by research *(8)*. This is done through country teams (also known as knowledge translation platforms) that are currently active in 42 countries in the Americas, Asia, Africa, and, most recently, in the WHO Eastern Mediterranean Region. EVIPNet promotes the use of scientific evidence in health- policy formulation, with the ultimate aim of strengthening health systems and improving service coverage *(9)*.

Leading international experts in knowledge translation have helped EVIPNet to develop state-of-the-art methodologies to help policy-makers, researchers and representatives of citizen groups to better learn and work together to produce evidence-informed health policies *(10)*. This involves learning to apply EVIPNet methodologies and policy implementation frameworks as well as preparing policy-options summaries that are country-specific and user-friendly for policy-makers.

EVIPNet tools help country teams prepare a policy brief by: (1) setting a priority; (2) clarifying the problem; (3) deciding on and describing options to address the problem (identifying and deciding on options for addressing the problem; finding evidence of the impacts, including costs, of the options; appraising evidence of the impacts of the options; summarizing evidence of the impacts of the options); (4) identifying and addressing barriers to implementing the options; (5) clarifying uncertainties and needs; and (6) priorities for monitoring and evaluation.

Typical of EVIPNet's pragmatic efforts to directly support evidence-informed health systems is capacity-building workshops which focus on producing and planning for the evaluation of policy briefs that address a specific policy problem or issue. In the workshops, participants also plan the organization of national policy dialogues, a well-structured activity at which policy briefs are discussed by policy-makers, researchers and stakeholders representing civil society. In keeping with the approach of 'learning by doing together, to better work together in a sustainable manner,' both a senior policy-maker or programme officer and a researcher from each EVIPNet country team draft a policy brief with delivery, financial and human resources and governance arrangements to address a policy issue.

EVIPNet exists as a global social network that interacts at country, regional and global levels to promote the exchange of ideas, findings and experiences. However, the main focus of its efforts is to strengthen the capacity and organization of country teams. The country team is usually linked to the ministry of health or a similar national institution, but it must have sustainable participation of at least two policy-makers and two researchers and must promote constant consultations with representatives of civil society.

After five years of experience, the biggest challenge ahead for EVIPNet is to acquire the funding needed to effectively support the work of country teams and to respond to the increasing demand of ministries of health around the world to establish new country teams. Therefore, the EVIPNet Global Steering Group requires that national public health authorities willing to create new country teams must provide basic human and material resources to strengthen institutional capacities. But the main requirement would be a strong political will to develop and implement high-quality evidence-informed health policies.

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Plenary 4

MDGs and epidemiology

Chairpersons: *Jigmi Singay*
Bjorn Melgaard

Session Coordinator: *Iyanthi Abeyewickreme*

Monitoring progress towards the achievement of health-related MDGs: are we in line with principles of epidemiology?
– *Sunil Senanayake*

Social determinants of health, MDGs and epidemiology: understanding and addressing health inequities – *U Than Sein*

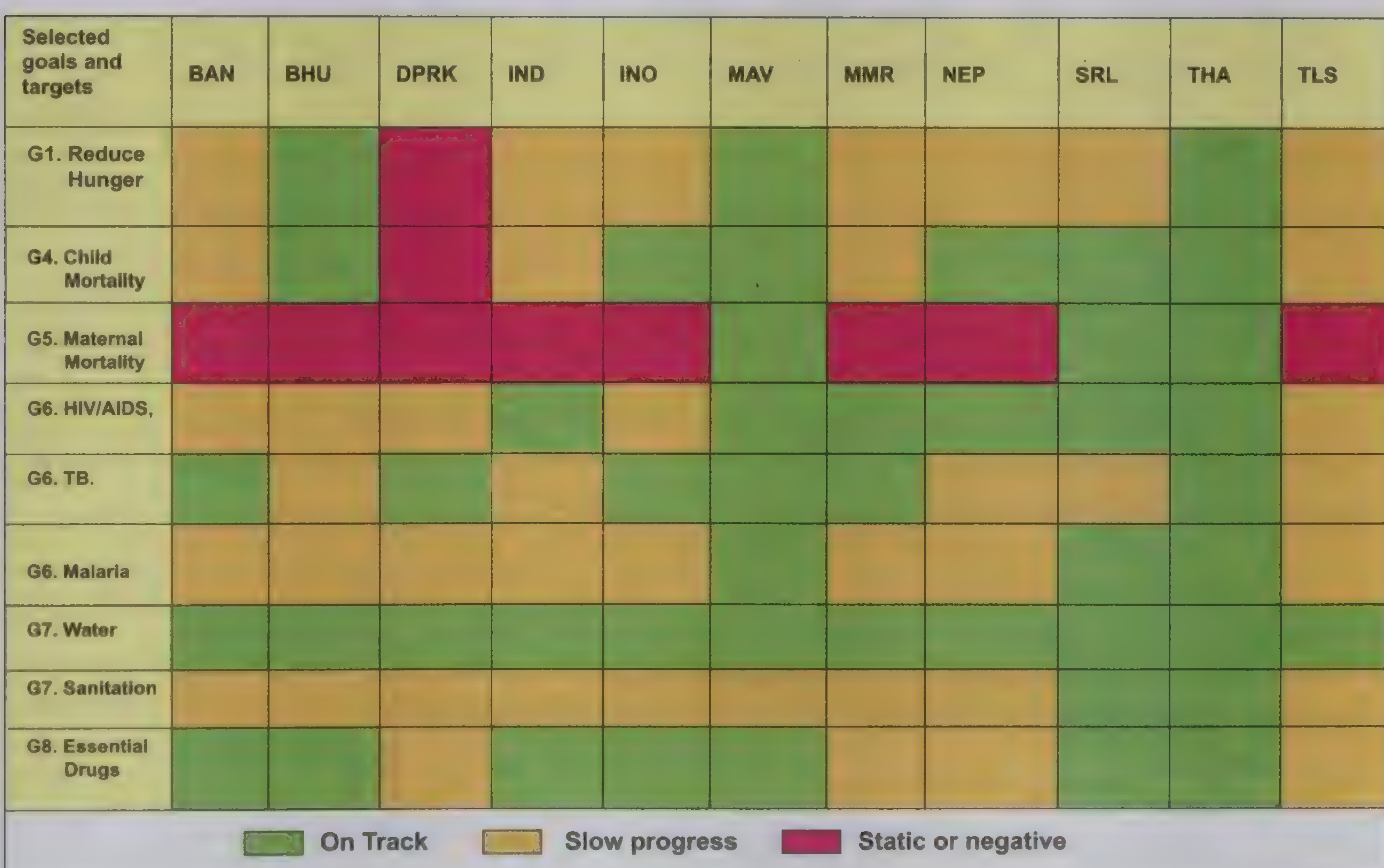
MDGs 4 and 5: the challenge of reducing maternal and child mortality – *Vinod Paul*

Monitoring progress towards the achievement of health-related MDGs: are we in line with principles of epidemiology?

Sunil Senanayake

The UN Millennium Summit in September 2000 made a historic commitment to improve the welfare of the world's poorest people within 15 years. The Millennium Development Goals (MDGs) cover poverty, education, gender equity, child mortality, maternal mortality, HIV/AIDS, malaria and other diseases, environmental issues and global partnerships. MDGs have eight goals, 21 targets and 60 indicators. Out of the eight goals, there are six health-related goals, and three of these are directly related to health. There are nine health-related targets and 23 indicators. The indicators are to be disaggregated by age, sex and urban-rural residence as far as possible.

Fig. 1: Progress towards achieving MDGs in WHO/SEAR countries, 2008

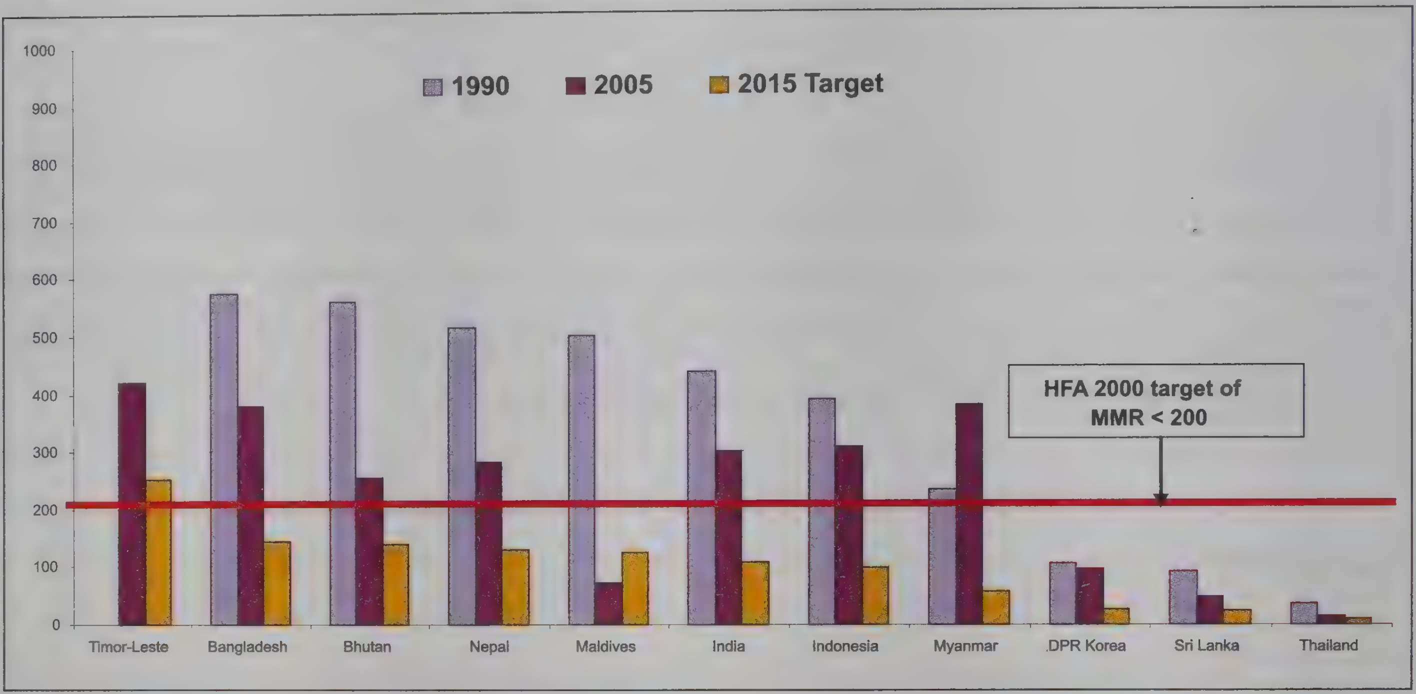


Source: Country MDG reports

The progress towards achieving the health-related Millennium Development Goals in the WHO South-East Asia Region is presented in Fig. 1. The Region has done fairly well in the case of certain MDGs, whereas in others a lot still needs to be done. For example, MDG 5, i.e. improving maternal

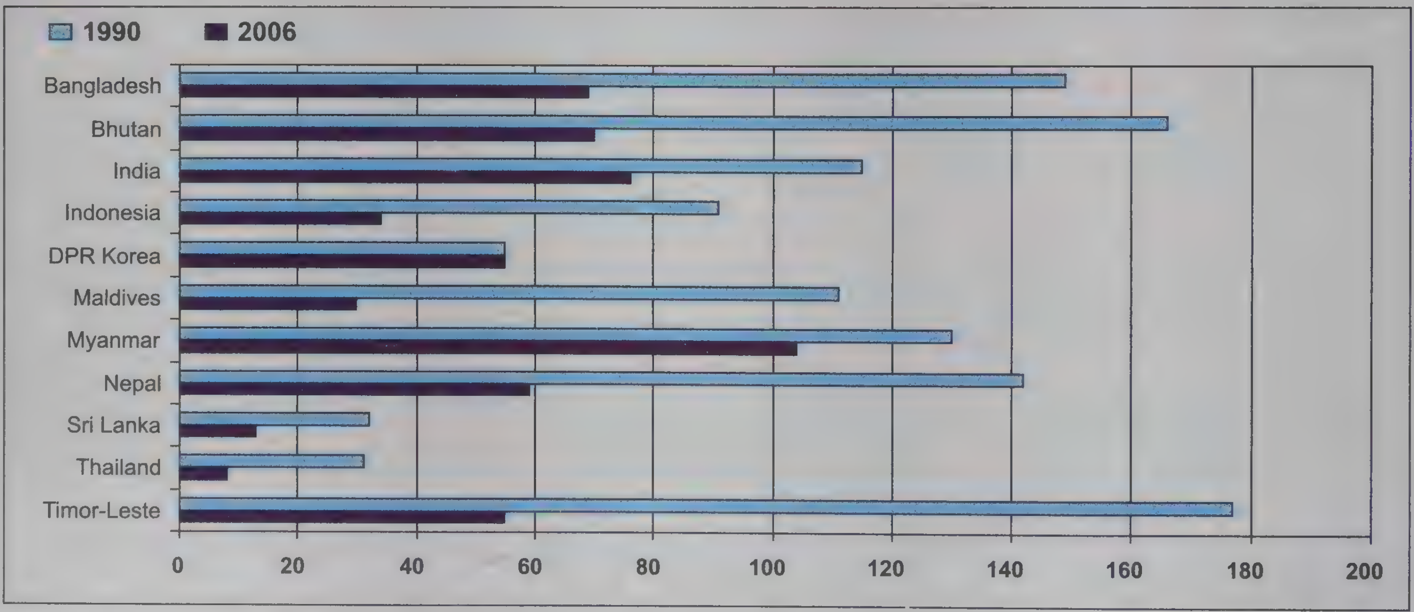
mortality, is a problem across the Region. Except a few countries, all the others are struggling to achieve this goal (Fig. 2). As far as the under-five mortality rate (U5MR) is concerned, only two countries have it less than 25 per 1000 live births but most others have it over 50 per 1000 live births (Fig. 3). Substantial progress has been made in reducing child mortality, particularly in terms of absolute numbers. But, despite these encouraging trends, more efforts are needed to achieve the target of a 66% reduction from the 1990 levels by 2015. Reducing child mortality increasingly depends on tackling neonatal mortality. Globally, about 40% of under-five deaths are estimated to occur in the first month of life, most of them in the first week itself.

Fig. 2: Maternal mortality ratio (MMR) in WHO/SEAR countries, 1990, 2005 and 2015 targets (per 100 000 live births)



Reference year of data for 2005 varies from 2000 to 2005
Source: Country MDG reports

Fig. 3: Under-5 mortality rate in WHO/SEAR countries, 1990 and 2006 (per 1000 live births)



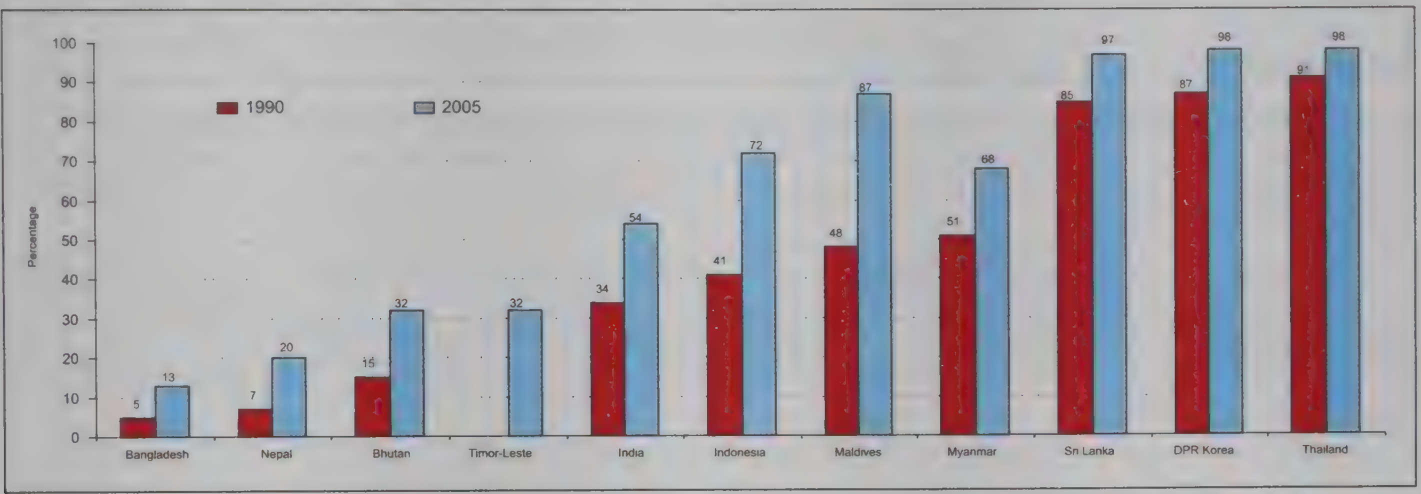
Source: Country reported data

The Inter-Agency Expert Group monitoring the progress of achievement of MDGs has defined that a 4.2% annual rate of reduction of infant mortality is required to achieve the targets of reduction of

child mortality by 2015. Similarly, annual rates of reduction have been defined for all other quantifiably measurable indicators.

Only four countries in the Region have achieved the MMR of the Health for All by the Year 2000 (HFA 2000) target. Even with that achievement, DPR Korea is struggling for further reduction of maternal mortality. The countries which are unable to achieve the required annual rate of reduction are struggling to provide skilled birth attendants for assistance at delivery (Fig. 4). Only four countries have achieved the required target for birth attendance by skilled personnel while others are lagging behind.

Fig. 4: Proportion of births attended by skilled health personnel in WHO/SEARcountries

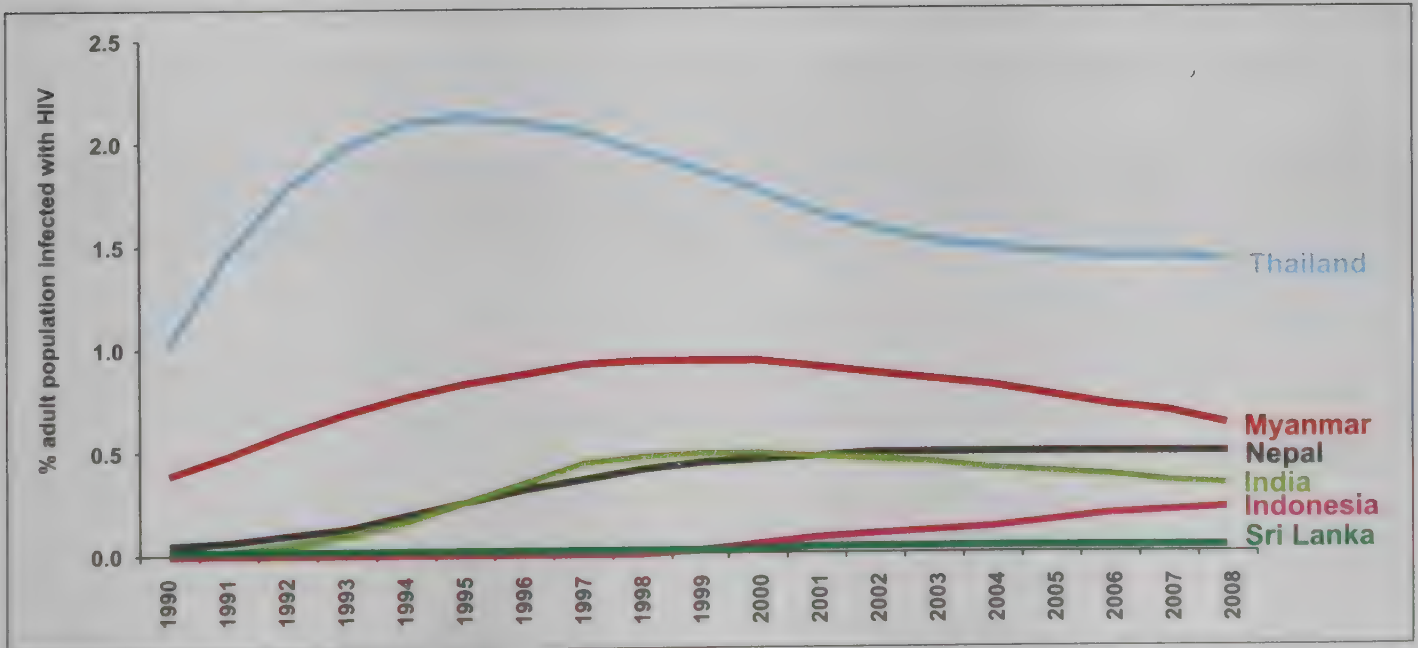


Reference year of data for 2005 varies from 2000 to 2005.
Source: Country MDG reports

Only four countries manage to provide for more than 80% births being attended by skilled health personnel and those are the same countries that have achieved HFA 2000 targets. Five countries provide less than 60% skilled birth attendance and three of them manage to provide the facility for less than 33% of births. Unless there are intensive interventions with adequate human resources to provide for maternal health, achieving the MDG 5 in the Region would be extremely difficult.

The MDG 6, to combat HIV/AIDS, malaria and other diseases, has three targets. Thailand, Myanmar, India and Sri Lanka have stabilized the HIV epidemic but the most worrying factor is that Indonesia is showing an increase in HIV prevalence (Fig. 5).

Fig. 5: Trends of HIV epidemic in a few selected countries in WHO/SEAR, 1990-2006



Source: HIV prevalence curves generated by Spectrum using surveillance data reported by Ministries of Health, WHO/SEAR countries

Significant reductions in the prevalence rates of tuberculosis (TB) cases have been shown by many Member countries, except Thailand and Timor-Leste. All other countries, except Timor-Leste, have shown significant mortality reduction. However, the estimated incidence remains, with a very slight decline over the years. The situation about malaria has not drawn due attention but it remains a big public health problem in the Region.

Provision of improved water supply in the Region is satisfactory but additional efforts are needed to provide sanitation in all Member countries. Provision of essential medicines to needy populations is an achievable target. However, it is necessary to consider continuous supply of low-cost essential medicines to all people.

Issues of monitoring MDGs

There are many issues concerning monitoring the progress of achieving MDGs in the Region. Some of these are country-specific while others are related to MDG indicators and the monitoring process, which are common to all countries.

One of the major issues is the quality, completeness and coverage of country health information produced by Member countries. Most of the countries are struggling with strengthening their health information systems (HIS). Yet, more efforts and more resources are required to streamline HIS in many of the countries.

The Country Vital Registration Systems (VRS) produce most of the vital statistics required for the denominator of most of the MDG indicators. Only Sri Lanka and Thailand register over 98% births and over 90% deaths but the quality of description of cause of death is far from satisfactory.

Research agendas in many countries in the Region are not very strong to supplement HIS; hence, evidence-informed decision-making and policy formulation are handicapped.

Under these circumstances, WHO and other UN agencies tend to develop estimates for many of the indicators as for baseline values as well as for annual estimates. Most of these estimates do not go parallel with the country-reported data and large discrepancies are noticed in some of the indicators, especially for maternal mortality estimates.

Considering the above, it is necessary to be cautious when interpreting data reported by Member countries to measure the progress of MDGs. Some countries have done well in reducing maternal and infant mortality but others are facing difficulties in achieving MDG targets, especially those countries which have not yet achieved the HFA 2000 targets. This can be explained by a comparison of IMR between 1990 (benchmark), 2008 (current status) and 2015 targets.

Table 1: Infant mortality: benchmark (1990), current status of reduction (2008), target (2015) and gap in three selected countries in WHO/SEAR

Country	1990	2008	Reduction 1990-2008	% reduction	Target 2015	Gap 2008-2015	% Gap
Timor-Leste*	184	93	91	49.5	61	32	52.5
Nepal	142	51	91	64.1	47	4	8.5
Sri Lanka	19	11	8	42.1	7	4	57.1

* known as East Timor in 1990

In 1990, the infant mortality rate (IMR) in three countries, i.e. Timor-Leste, Nepal and Sri Lanka, was 184, 142 and 19 per 1000 live births respectively. In 2008, Timor-Leste has reduced the IMR to 93, Nepal to 51 and Sri Lanka to 11 per 1000 live births. The reduction in the last 18 years is 91 per

1000 live births in Timor-Leste; 91 in Nepal and a reduction of 8 per 1000 live births in Sri Lanka. By 2015, according to the MDG target, Timor-Leste should bring the IMR down to 61, Nepal to 47 and Sri Lanka to 7. Timor-Leste has a very big gap to bridge. Nepal possibly would achieve this target, but for Sri Lanka this may be difficult. Just by comparing these numbers the health situation in these three countries cannot be assessed or understood. Can one say that Sri Lanka is not performing well in the health sector? MDG monitoring is just working with numbers unless it is interpreted and compared with country health systems. The most important factor is that countries should adopt appropriate health policies by monitoring the progress of achieving the health-related MDGs.

The problems related to MDG indicators and their monitoring process are multiple. Some of the important issues are discussed below. There are multiple indicators in the monitoring framework. For example, the indicator to monitor the progress of achieving MDG targets for reduction of tuberculosis, i.e. "incidence, prevalence and death rate associated with tuberculosis". This is not a single indicator; it is a combination of three indicators.

Some of the indicators are not defined properly; for example, "the proportion of population with access to affordable essential drugs on sustainable basis". Here "access" has not been defined. Affordability may also differ from country to country. The list of essential drugs may also vary from country to country. Sustainability is another questionable factor which has not been defined properly. The source of data for this indicator has not been identified; hence, it is not reported.

There are some MDG indicators that are not measurable; therefore, proxy indicators have been suggested to measure the trend. For example, HIV prevalence among population aged 15-24 years is a proxy to monitor the trends in HIV incidence. The proxy proposed is HIV prevalence in young women aged 15-24 years who attend antenatal clinics. But, in practice, the records for women 15 to 24 years of age are not kept separately in antenatal clinics, which have aggregated data of mothers attending antenatal clinics, i.e. age group between 15-49 years.

Another problem is that different groups are measuring the estimates using different methods/ statistical models for estimation; for example, for child mortality estimation, interagency group comprises WHO, Pan American Health Organization (PAHO), UNICEF, the World Bank, UNDP, CELADE (Centro Latinoamericano de Demografia) and academics. The maternal mortality working group comprises WHO, UNICEF, the World Bank, UNFPA, UNDP and academics. The Joint monitoring programme for water supply and sanitation comprises WHO and UNICEF. The UNAIDS reference group on HIV/AIDS estimates, modelling and projection comprises the UN Population Division, the US Bureau of Census, UNICEF, WHO and UNAIDS. The malaria monitoring and evaluation reference group comprises WHO, UNICEF, the World Bank and academic groups.

Another challenge of MDG monitoring is the lack of baseline data, i.e. the 1990 data is lacking in many of the countries which have to be estimated. Weak health information and statistical systems are another major challenge. In countries where monitoring is needed the most, the health information and health systems are the weakest. These countries are showing less progress towards achieving the MDGs. Yet another challenge is that from time to time, the groups responsible for monitoring different MDGs adopt different estimation methods. As a result, either the baseline has been moved or the targets have been moved. If the baseline or the targets are moved, monitoring becomes difficult. The estimates with higher uncertainties are most difficult to monitor as is illustrated by maternal mortality ratio estimates between 2000 and 2005. The 2000 estimates show the upper range in the South-East Asia Region as 590/100 000 live births but in 2005 it is 630/100 000 live births. The global situation is the same; in 2000, the upper range is 620/100 000 live births and in 2005 it has increased to 650/100 000 live births. When the estimation method is changed, the estimated values also get changed.

Another issue relates to the kinds of statistics are being used to measure the progress of MDGs. Sometimes registered data collected from a primary source are used with no adjustments or corrections. The second type of data used is primary data which are analysed and then certain adjustments are made; for example, estimates from household surveys. The third type of data used is predicted data which are generated from mathematical models, either forecasting (projections) or far-casting. Projections are made from previous year's data. Sometimes far-casting is done from out-of-place estimates for a country. Most of the indicators are either adjusted data or predicted data. Only TB treatment success rate is measured with registered data which are collected from the service statistics. At least half of the indicators are monitored using predicted estimates. There are issues related to predicted estimates. Different assumptions have to be used depending on the analytical methods or type of weightage that is to be used for a particular data series.

Uncertainties surrounding the estimates make monitoring of the trends less reliable. For example, the data in Timor-Leste has different sources such as census data, health service data, demographic and health survey and the multiple cluster indicator survey data. These are different sources, but using mathematical models certain values can be predicted. Models have used these data and estimated values for different years. Because of the uncertainty in the values there is a high uncertainty in prediction also. In contrast, Indonesia has a lot of surveys, data points and data sources and most of these lie close to each other. In that case the prediction is more reliable.

Registration systems can be used to monitor MDG indicators. For example, instead of making estimates for the prevalence of underweight children, birth registers and nutrition registers of countries can be used. Similarly, for monitoring immunization, immunization registers can be used. Information on births attended by skilled health personnel can be derived from the birth registers. Infant and under-five mortality by age, sex and causes can be derived from vital events registration systems. The quality of cause-of-death information is high in the USA, Europe, Australia, New Zealand, etc. In SEA Regional countries, it is of limited use due to its low quality. Therefore, it is necessary to concentrate on improving the cause-of-death data and improved projection systems have to be used.

WHO and other international agencies are continuing to record the most recent estimates for MDG indicators with increased transparency, comparability and consistency. Concentrated efforts are needed to support countries to enhance data availability and its quality, with particular emphasis on birth and death registrations and certification of cause of death. Considering the above facts, and monitoring the progress of achieving MDGs, it is important to assist countries which are lagging behind in the areas of health systems strengthening, health information systems development, vital registration development and to support health programmes with appropriate interventions. Otherwise monitoring of MDGs will remain as an academic exercise only.

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Social determinants of health, MDGs and epidemiology: understanding and addressing health inequities

U Than Sein

In September 2000, the UN Millennium Summit adopted the UN Millennium Declaration as a framework for development. The plan was meant for UN Member countries and development partners to work together to increase access to resources for reducing poverty and hunger and tackling ill health, gender inequality, lack of education, lack of access to clean water and environmental degradation. Within the UN Millennium Declaration, eight Millennium Development Goals (MDGs) were established with a set of targets for 2015. A number of indicators have been identified for monitoring progress, several of which relate directly to health.

Regional overview

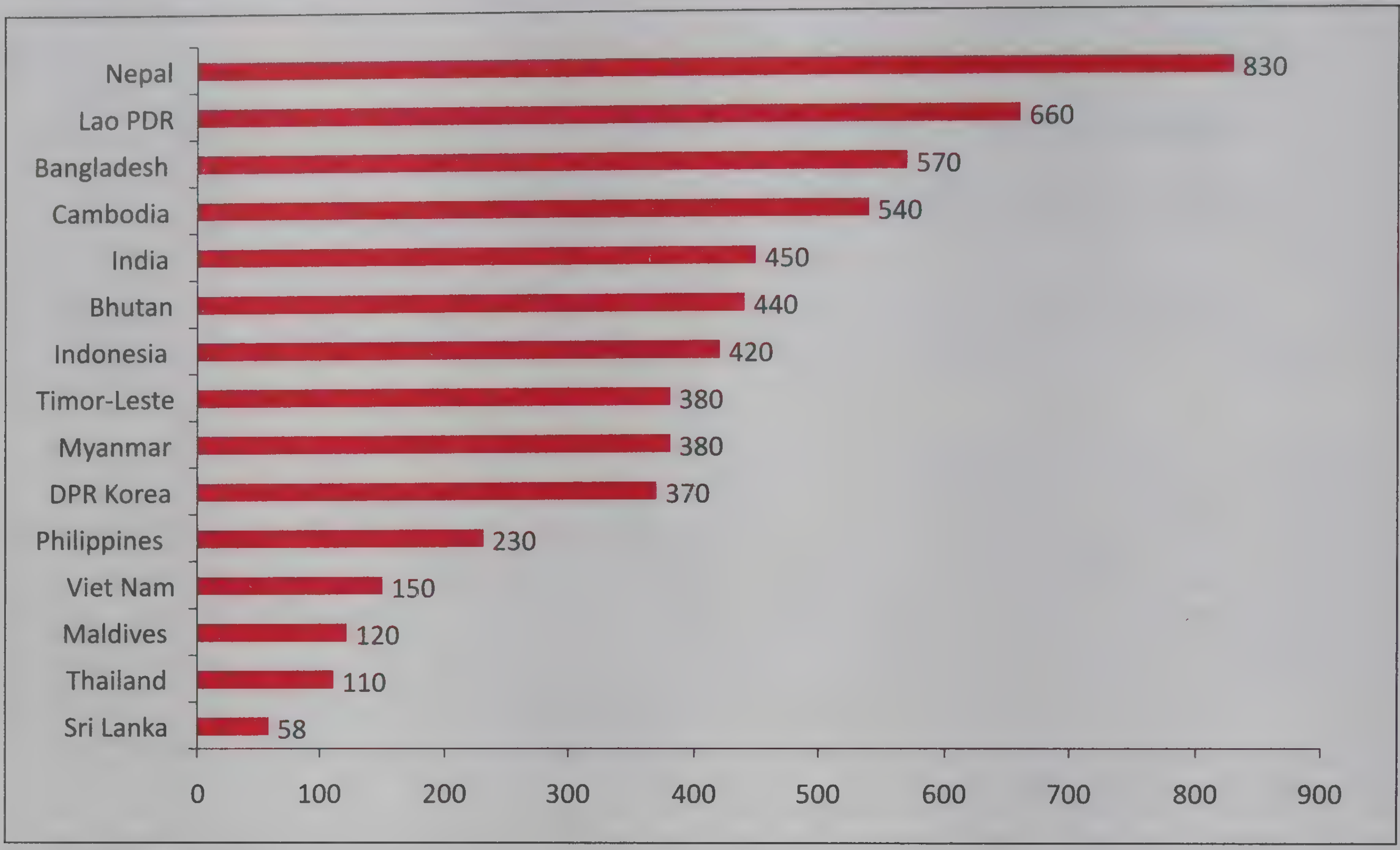
Globally, the proportion of children under five years of age suffering from undernutrition, according to WHO Child Growth Standards, declined from 27% in 1990 to 20% in 2005. The progress was uneven and an estimated 112 million children were underweight. The progress on Target 2 of Goal 1, i.e. reduction in the number of underweight children, needs to be accelerated as seven countries out of the 11 that comprise the South-East Asia Region of WHO are making insufficient progress, and one country is progressing considerably slower than the rest. Only three countries show good progress.

The Goal 4A was set for reducing child mortality by two thirds by 2015 from the 1990 level. Globally, the number of children who die before their fifth birthday has been reduced by 27% from 12.5 million estimated in 1990 to 9 million in 2007. This reduction is due to a combination of interventions, including the use of insecticide-treated mosquito nets for malaria, oral rehydration therapy (ORT) for diarrhoea, increased access to vaccines for a number of infectious diseases, and improved water and sanitation. While a majority of the countries in the Region have made considerable progress in reducing under-five child mortality, the rest have made little or no major progress in recent years.

The global maternal mortality ratio (MMR) of 400 per 100 000 live births in 2005 has barely changed since 1990. Every year, an estimated 500 000 women die in pregnancy or childbirth. Efforts to achieve reduction in maternal mortality (Goal 5) need serious attention from all concerned as only three countries in the Region have made good progress, and the rest have been very slow and are unlikely to achieve the targets by 2015 with their current rates of success. Access to skilled attendance during pregnancy and childbirth is still a major problem.

The HIV/AIDS epidemic remains at a low level, and, overall, the regional prevalence of the disease is estimated to be 0.3%. Five countries – India, Indonesia, Myanmar, Nepal and Thailand – are experiencing a high burden of HIV. Thailand is the only country that has successfully reversed the HIV epidemic. There are early indications of a decrease in HIV prevalence in Myanmar and the southern states of India. Unsafe sex and injecting drug use are currently the main drivers of the epidemic in the Region. A scale up of an integrated package of prevention, care and treatment services is necessary to halt and reverse the epidemic and mitigate its impact.

Fig. 1: Maternal mortality ratio (MMR) per 100 000 live births, by selected Asian countries, 2005



Source: World Health Statistics 2010, Interagency Estimates for 2005

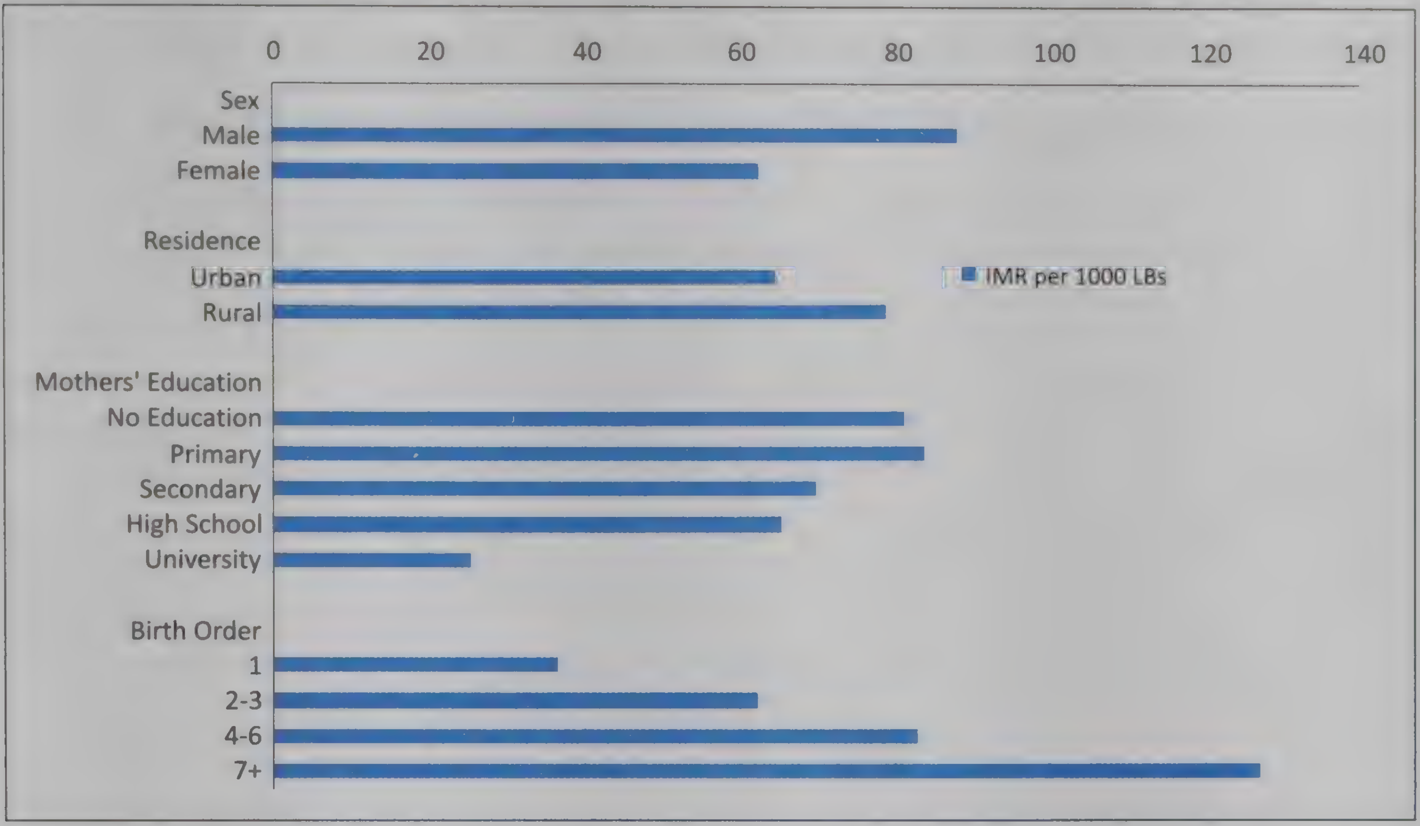
The trends of the estimated TB incidence rates with reference to the 1990 baseline indicate that the Region as a whole has already achieved a reversal in TB incidence. Similarly, the estimated tuberculosis prevalence and mortality rates reflect a decrease in most Member countries, indicating that the expected reductions in prevalence and mortality would also be achieved by 2015. This is also supported by the current trends in treatment success and case-detection rates.

An estimated 1.2 billion people or 83% of the total population of the Region lives in malaria-risk areas. All countries, except Maldives, have indigenous malaria transmission, predominantly *Plasmodium falciparum and Plasmodium vivax*. Sri Lanka is targeting eradication of local transmission of malaria by 2012, which will surpass MDG targets.

Social determinants

The Region consists of a number of countries which are not only poor but they also shoulder a significant proportion of the global disease burden. People who are economically or socially disadvantaged suffer from worse health conditions than their better-off counterparts. There is no great mystery as to why this happens. Poor people encounter high rates of illness due to infectious diseases and malnutrition because of lack of food, unclean water, low levels of sanitation and shelter, failure to deal with environments that lead to high exposure to infectious disease agents and lack of appropriate medical care. An increasing burden of noncommunicable diseases among the poor is an emerging concern. This raises the question of what action can be taken at different levels – individual, community, government – to tackle these inequities. Operationally, the important question would be how and through what mechanisms can governments and civil society work together to reduce health inequities. While addressing major health problems of children under five years with medical interventions, it has to be realized that social determinants of health have played a major role in tackling the issue of infant and child deaths (Fig. 2).

Fig. 2: Infant mortality rate (IMR) per 1000 live births by social determinants, Myanmar, 2001



Source: Myanmar Family and Reproductive Health Survey-2001, Department of Population & UNFPA, 2002

In order to support the work of the WHO Commission on Social Determinants of Health, the WHO Regional Office organized case-studies in seven countries, viz. Bangladesh, India, Indonesia, Maldives, Nepal, Sri Lanka and Thailand. The analysis of information from these seven countries revealed a strong association between a variety of social and economic inequalities and health inequities.

For instance, a child born in Nepal is 12 times more likely not to live till his or her fifth birthday unlike in Thailand. In India, children born in the poorest 20% households are more than three times as likely to die before their fifth birthday compared to children in the richest 20% of households.

Within countries, health inequities are dramatic, except in Sri Lanka and Thailand, even though in all countries economic growth has been generally strong and improvements in overall levels of health are visible. Maternal and child health are still major concerns. For example, skilled birth attendance, an important determinant of maternal mortality, is less than 5% among the poorest 40% of women in both Bangladesh and Nepal.

The results of the analysis indicate that inequities in health systems contribute to 19%-25% of inequities in skilled birth attendance, while more than 50% of such inequities are accounted for by the socioeconomic position of women. Intermediary determinants contribute to only 6%-10% of inequities in skilled birth attendance. While addressing medical problems with medical interventions, it has to be realized that social determinants of health have played a major role in tackling the issue of infant and child deaths.

Four main areas of action with policy implications are identified. First, the contribution of factors outside the health sector to health inequities is clear. From the perspective of the ministries of health, this reinforces the need for effective intersectoral action if all sources of health inequities are to be tackled. This will involve engaging other branches of government, including government at different levels (e.g. provincial, local), as well as civil society. Second, the countries in the Region that have been successful in eliminating health inequities have almost universal coverage of basic health services. Third, the results reveal that poverty and food security are the most critical issues to address if child

malnutrition is to be reduced. Fourth, much can be learned by increasing opportunities for exchange of information between countries. Information exchange and dialogue would vastly improve the knowledge base available to policy-makers in the South-East Asian countries given their similarities.

Role of epidemiology

Modern epidemiology, despite different perceptions and definitions, remains valid and relevant as a basic discipline of public health. The common inclination to associate the word epidemiology exclusively with disease causation, epidemics and communicable diseases is no more valid. The study of diseases goes beyond the secondary and tertiary levels of causation, as in the case of noncommunicable diseases. This means that it is highly relevant to the study of risk factors and their determinants. Today, scientific methods and other descriptive and analytical tools in the application of epidemiology have gone to an advanced stage. Effective prevention and control strategies can be developed based on epidemiological methods and principles.

The major challenge in the WHO South-East Asia Region is inadequate number of professionals and other non-professional health staff, who have been trained in epidemiology. The present-day training in epidemiology is still focusing on communicable diseases. Lack of suitably-trained human resources at each level of national health administration, including health research and medical education institutions, has remained a persistent constraint in the application of epidemiology at a wider scale. The use of epidemiological principles in public health and realizing the social determinants can only ensure a reduction in the burden of both communicable and noncommunicable diseases.

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MDGs 4 and 5: the challenge of reducing maternal and child mortality

Vinod K. Paul

Member countries in the South East-Asia Region of WHO have made good progress towards the achievement of the Millennium Development Goals (MDGs) 4 and 5. According to the UNDP report card, between 1990 and 2005, the under-five mortality improved in most regions of the world. The improvements were slower in Africa but quite remarkable in other regions. Similar trends could not be established for maternal mortality ratio (MMR) as it is difficult to measure MMR. However, over the same time period, skilled birth attendance has increased in all regions.

There are 68 countries in the world which account for 97% of maternal and child deaths. These are the priority countries for the initiative called 'Countdown to 2015', which is an independent academic initiative supported by a large number of partners. They keep a track of the coverage levels in addition to tracking the goals and indicators in these countries. Much of the world is lagging behind in the achievement of the MDG 4 as of now. Three countries in the WHO South-East Asia Region, i.e. Nepal, Bangladesh and Indonesia, are on track for MDG 4, whereas India and Myanmar are not on track.

The tracking of MMR is not easy because systems do not exist which can track this indicator effectively on a regular basis. World health statistics show MMR per 100 000 live births to be 58 in Sri Lanka, 110 in Thailand and 830 in Nepal. DPR Korea, Myanmar, Indonesia, Bhutan, India and Bangladesh are all doing poorly. In Bangladesh and India, there is an undercurrent of change. In Bangladesh, although the skilled birth attendant rates are low at about 20%, but, interestingly, it is saving maternal deaths. It is a sort of an enigma that with a low skilled birth attendant rate, maternal mortality reduction is taking place. Some people have attributed this to the availability of antibiotics and more access to emergency care in the private sector.

It needs to be underlined that the Region has different rates for maternal and under-five mortality, indicating heterogeneous epidemiology and programme settings. Hence, all countries cannot have one single strategy. There is an urgent need to appreciate this and develop a context-driven approach for the entire Region.

In the 68 high-priority countries, the coverage of life-saving interventions is low. Just about 50% of the population is receiving skilled care for delivery. The case management coverage of pneumonia is just above one third. For these interventions to be effective, the coverage has to be above 80% to 90%. If the drug does not enter the body, pneumonia will not be treated. The endeavour has to be really to ensure that these interventions reach a high level. If the Region does not perform, global MDGs will not be attained as it alone contributes about one third of the global burden of maternal and child deaths. India is the biggest contributor, followed by Bangladesh and Indonesia. Hence, the Region has to make a strong endeavour to achieve the global goals of MDGs 4 and 5.

As far as coverages are concerned, Bangladesh is on track, where immunization is about 80% and skilled birth attendance rate is 20%, but antenatal care (ANC) rates are about 40% to 50%. In Indonesia, the immunization rate is about 80%, skilled birth care is close to 75%, ANC also has a fairly high coverage, but MMR is high. Myanmar is missing the target for MDG 4; the immunization rate is 80%, skilled birth care is about 60%, antenatal care is at about 75%, and it has a high MMR. Nepal is on track as the immunization rate has gone up in recent years, but low skilled care at birth is a very serious concern, and antenatal coverage is also relatively low. India is also missing the MDG 4 target; here immunization rates are relatively low at about 60%, antenatal care is 75% and skilled birth attendance coverage is about 52%.

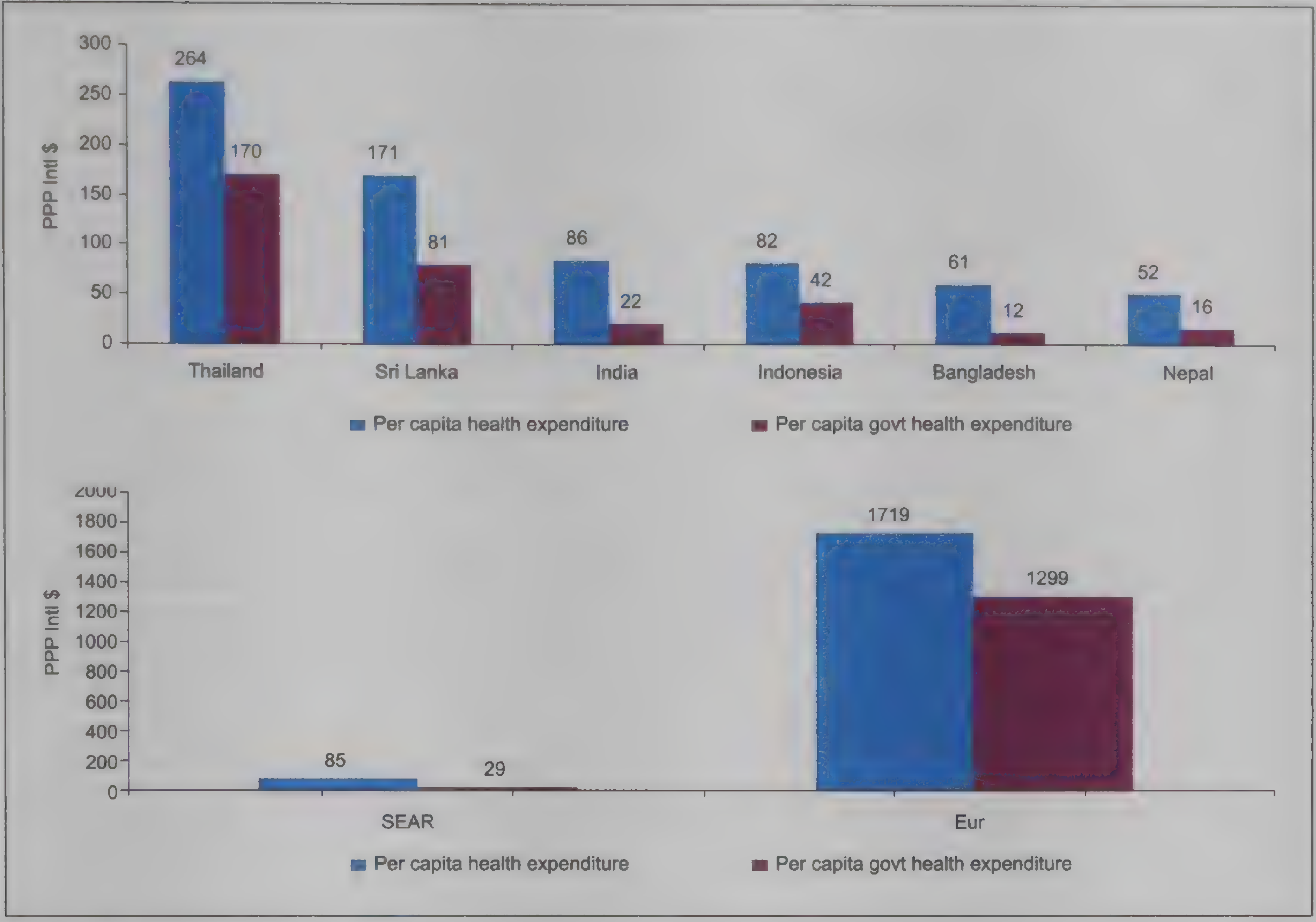
It is important to record that, in 2005, India had an MMR of 252 per 100 000 live births against 540 in 2000. The MMR got reduced in 2005 to almost half of the 2000 level. Something is indeed happening; maybe it is due to the overall development in the country. Now, perhaps a quicker pace might be happening as a result of the *Janani Suraksha Yojana* (plan for protection of pregnant women) and progress made in referral transport and other elements as part of the National Rural Health Mission (NRHM). But, for the child and infant mortality rate, India is missing the target. What is worrisome is that the neonatal mortality rate, which is half of the under-five mortality rate, is hardly changing. In the last five years, it declined by just one point, which is negligible. The IMR is also changing slowly, at less than two points a year. This is a cause for serious concern. An IMR of less than 30/1000 live births is the requirement for attaining the MDG 5. India might have 43/1000 live births in 2015, which would be 13 points higher than the target. It seems urban India would have an IMR of 31/1000 in 2015; rural India would be at 47/1000, and the overall IMR would be 43/1000 live births.

In India, the states of Goa and Kerala are already having a very low IMR, well below the MDG 4 goal. Only three other states that will make it to the MDG 4 target are: Maharashtra, Tamil Nadu and West Bengal. All other states will be above 30/1000 live births. Punjab and Himachal Pradesh may be close to the target. Rural India will be missing the target. There is a great heterogeneity in different states. Progress is unequal, particularly in rural India. This is not surprising because the immunization coverage is very low in many states. In the case of children receiving oral rehydration salts (ORS) in diarrhoea, some states have actually dipped in the last few years and some have improved a little. Overall, India is far from attaining the target of universal coverage of key interventions. In institutional delivery, Bihar has made some progress but Jharkhand shows no progress; Madhya Pradesh has made some progress, but, overall, half of the mothers there do not have institutional deliveries. It is again a major cause of concern. Sufficiently high coverage of interventions is required to attain the MDGs 4 and 5.

It is due to weak systems that the coverage of the key interventions is low. It is an intervention coverage which makes a difference in the target population, i.e. women and children. A good health system is needed for good interventions to reach the target individuals. Policy-decisions are needed in planning for finance, human resources, infrastructure, supplies, managerial systems, information systems, as well as community participation.

Why is it that some of the key countries in the WHO South-East Asia Region are doing poorly? Health expenditure in Thailand, which has done well, is \$264 per capita; in Sri Lanka, it is \$171 per capita. In the rest of the countries, which are doing poorly, the overall health expenditure is low (Fig. 1). Government expenditure is even lower. Overall, the Region is doing very poorly in financing for health. In Europe, for example, expenditure from the governments is almost 50 times higher. If enough resources are not generated, both from within countries and outside, the health status of the people will not change and mortality rates will not decrease. The density of doctors, nurses and midwives is also quite low, e.g. in India, it is 1.9; in Indonesia, it is 1; in Nepal, 7; and in Bangladesh, it is 6.

Fig. 1: Health expenditure in 2006

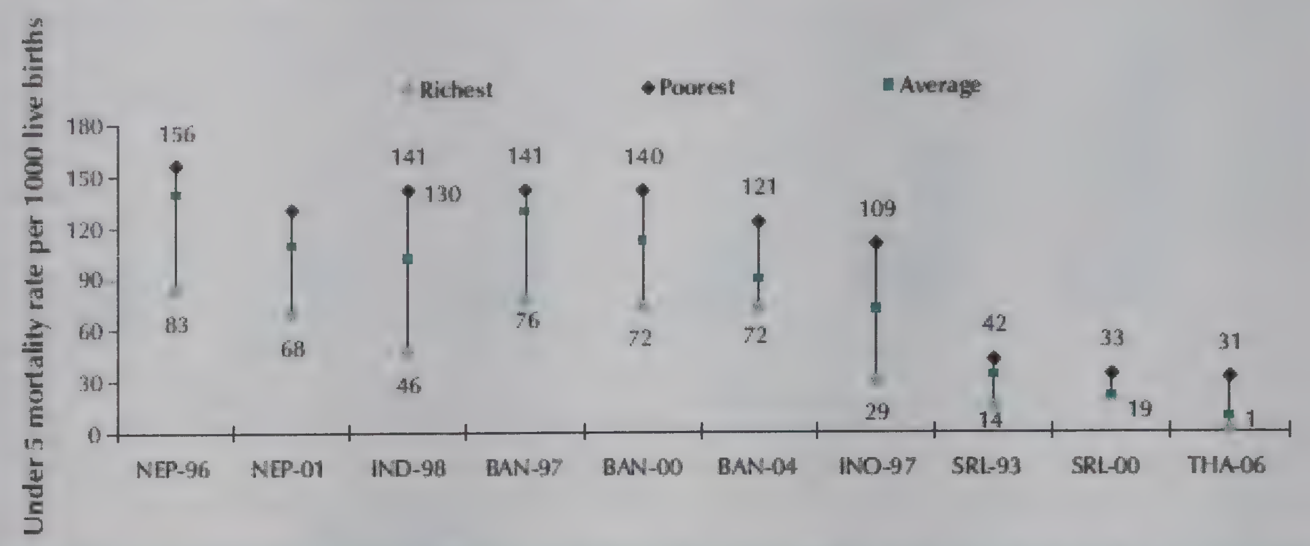


Source: World Health Statistics, 2009

The countries in the Region have to do better to bring down the maternal and under-five mortality rates. The interventions are not reaching 90% level. To reach this level, different countries have to adopt different strategies because they have varied health systems and health problems. The differences in coverage are quite wide between the rich and the poor (Fig. 2). The richest in India have the under-five mortality of 46/1000 live births while the poorest have 141/1000. In Indonesia, it is 109/1000 among the poorest and 29/1000 among the richest. There are huge inequities in having access to key services like skilled birth attendants (Fig. 3). The rich are getting the services but the poor people's access to skilled birth care is abysmally low. These inequalities have to be addressed because it is quite possible that when programmes, finance, human resources and interventions are pushed, the rich will get more access and MDGs may paradoxically be achieved but that will be a Pyrrhic victory. Health systems need to be reorganized and reoriented in such a way that they bring about equitable improvement for all and the poorest particularly are not left out.

In Thailand, the under-five mortality was reduced by 32% in ten years from 1990 to 2000. The difference between the top and the bottom quintile was 26% in 1990, which shrunk to 10% in 2000. In 1990, the country was away from the equity line, but in 2000, it came close to the equity line (Fig. 4). Reduction in child mortality can, therefore, be achieved with good policies, which can also simultaneously decrease inequality. This calls for equity-driven programmes which are planned and implemented, with no user fees, by adopting community-based approaches and ensuring adequate financing.

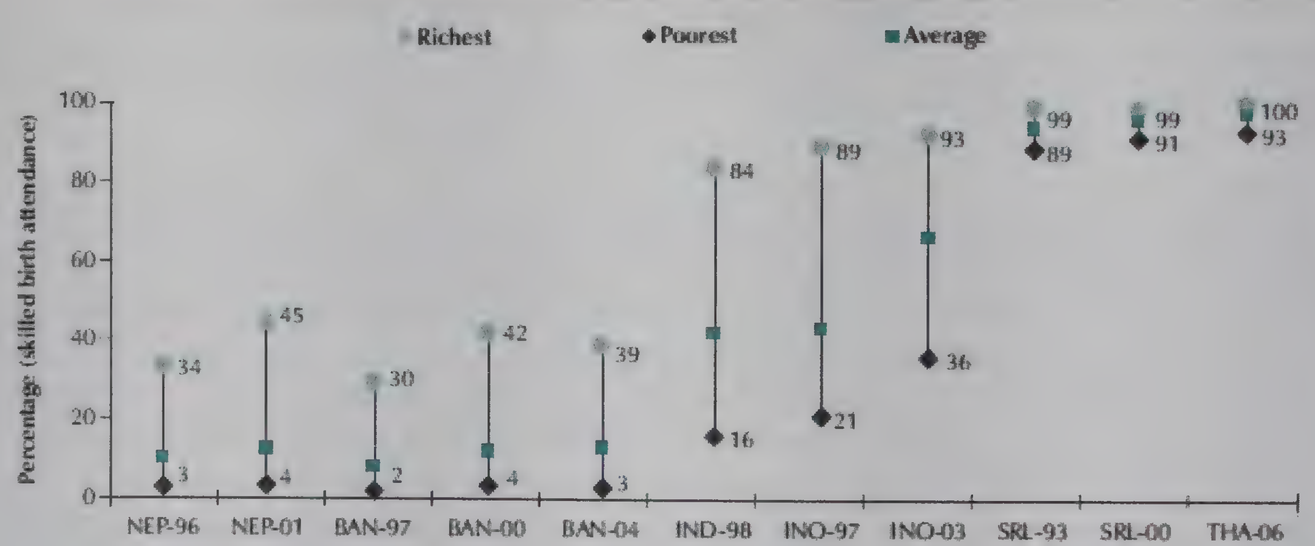
Fig.2: Huge inequities in WHO South-East Asia Region: Under-five mortality rate



Source: Demographic and Health Surveys (Bangladesh, India, Indonesia, Nepal, Sri Lanka); Multiple Indicator Cluster Survey (Thailand)

WHO/SEARO 2009

Fig.3: Huge inequities in WHO South-East Asia Region: Skilled birth attendance



Source: Demographic and Health Surveys (Bangladesh, India, Indonesia, Nepal, Sri Lanka); Multiple Indicator Cluster Survey (Thailand)

WHO/SEARO 2009

Fig. 4: Child mortality reduction in Thailand with decrease in inequities

- Scaling up of primary health care
  - Primary Health Centre in each village
  - Focus on MCH, FW, infections
  - Emphasis on health education, sanitation
  - Doubling of community hospitals
  - Provision of essential drugs
- Improved financial accessibility
  - Insurance coverage for the poor
  - No user charges

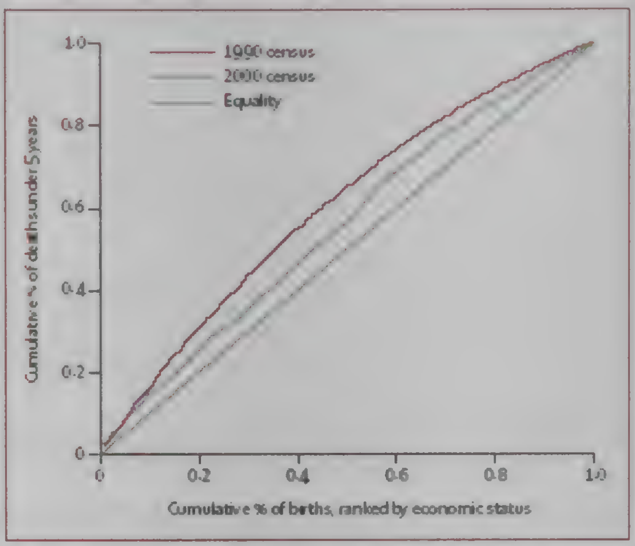


Figure 3: Concentration curves of the U5MR, 1990 and 2000 census

Source: Vapattanawong P, et al. *Lancet*, 1997;369, (9564):850-855

To conclude, MDGs 4 and 5 are still elusive in countries which have a high disease burden. Global MDGs would depend on the progress made in the South-East Asia Region, particularly in India. Notwithstanding the equity issues, the Region seems to be doing better in the case of MDG 4 than in MDG 5. MDG 5 is a great challenge and a huge effort is needed. Key countries must address health system deficiencies, especially human resources and financing. Special efforts to favour the poor are mandated by the appalling inequities that prevail in many countries.

Plenary 5

Epidemiology for the future: challenges and opportunities

Chairpersons: *Ann Marie Kimball*
Ron Waldman

Session Coordinator: *Suzanne Westman*

Methods and application of molecular epidemiology and modelling in disease control – *Masato Toshiro*

Application of GIS in monitoring drug resistance – *Pratap Singhasivanon*

The future of epidemiology: how is our science changing? – *Ann Marie Kimball*

Towards universal childhood immunization: why we must do and how we might? – *Stanley I. Music*

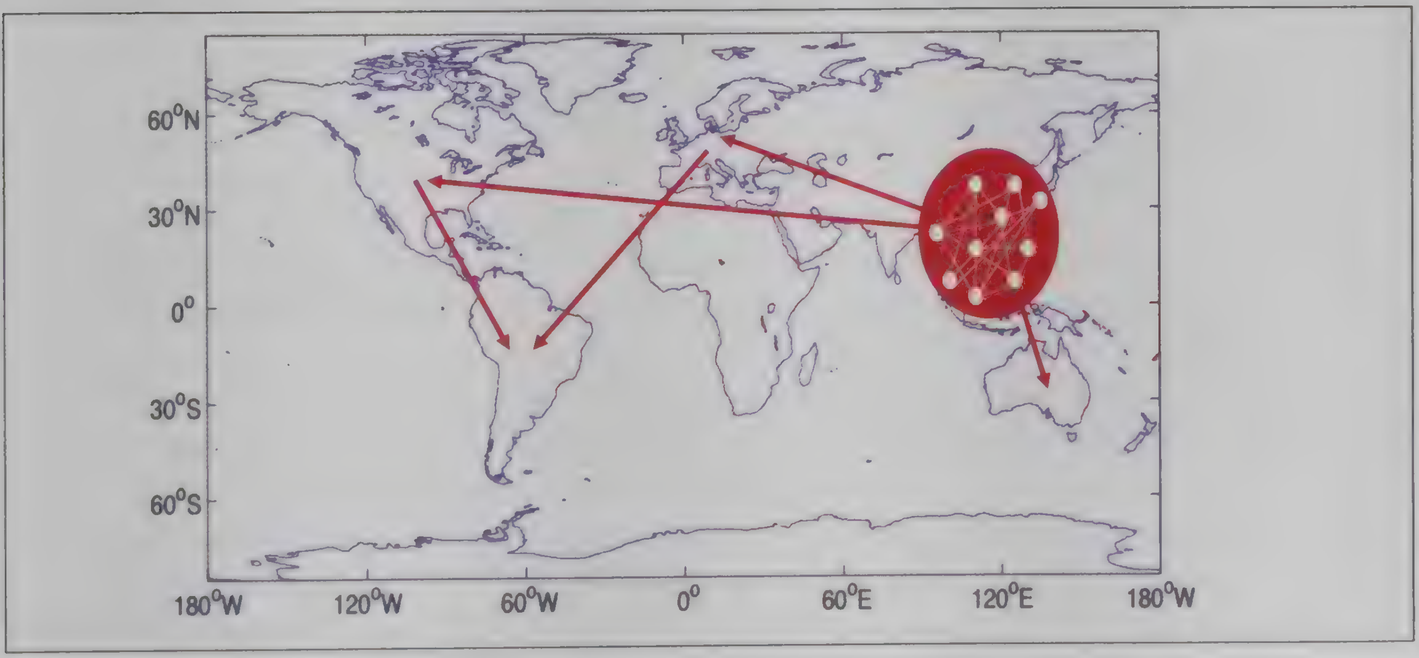
Methods and application of molecular epidemiology and modelling in disease control

Masato Toshiro

Influenza surveillance is a very good illustration of the application of molecular methods to epidemiology. The WHO Global Influenza Surveillance Network has four collaborating centres which receive surveillance data and viruses from more than 130 national influenza centres. Influenza viruses are characterized to provide information for risk assessment. Selection, development and evaluation of the seasonal and pandemic vaccine candidates are also done at these centres. Feedback of the surveillance data is provided to the participating laboratories and it is also published promptly. Annual consultation reports are put up on the WHO website.

On the basis of molecular epidemiological analysis, the Global Influenza Surveillance Network has tentatively concluded that 87% of the seasonal influenza viruses originate from somewhere in the south-east Asian countries. Every year, a new variant virus appears in these areas which then spreads to southern and northern hemispheres. This drift of the virus tends to go to Europe first, and then one way to Africa and the other to North America and then to the southern America. It takes about nine months from the starting point in Asian countries to complete the circulation in the north. By then, the surveillance of the seasonal influenza performed in South America and Europe might be too late to select vaccine viruses for the coming seasons. The epicentre exists somewhere in south-east Asia from where viruses spread to remote areas. To pick up the vaccine-candidate viruses that appear about six months before, surveillance systems must be strengthened in Asian countries (Fig.1).

Fig. 1: Schematic of the dominant seeding hierarchy, rather than local persistence, of seasonal influenza A(H3N2) viruses



The characteristics of interest to public health are monitoring the appearance and change of novel viruses with pandemic potential as well as any change in seasonal viruses. They include antigenic properties, virulence, host-range and antiviral drug resistance. The possible images of the pandemic virus are from bird species, especially the aquatic migratory birds, which are the original natural hosts of all influenza viruses, including the human influenza viruses.

Pigs are thought to be an intermediate host from birds to humans. In the natural setting, 16 different subtypes of influenza A viruses are recognized. These are low pathogenic viruses; they will not kill bird species. However, over a period of time the H5 and H7 subtype viruses may change to highly pathogenic ones. The H5N1 is a representative virus which is still circulating among wild birds and poultry in many areas. The novel virus of pandemic potential appears from the bird viruses which are found in pigs. Pigs can be infected by both avian and human viruses. The H5N1 virus has been reported to infect pigs subclinically in China and Indonesia and the current pandemic H1N1 virus has also been reported to infect pigs. This situation is increasing the risk of the emergence of an H5N1 pandemic.

The influenza virus has eight segmented RNA genes and each gene segment replicates independently in the infected cell. Re-assortment of the gene segments is some kind of a gene combination that occurs very easily in pigs as a gene-mixing vessel when infected with both the viruses. When a pig is doubly infected with human and avian viruses, genetic re-assortment leading to a novel virus may occur. As a result, some of the avian viruses acquire the capacity to transmit from human to human very easily. What mutation is necessary to jump over this species barrier? Molecular epidemiology tries to find answers to this question. The specific characteristic of interest for public health is the genetic-change monitoring.

The current H1N1 was first reported as a novel virus in California, USA, which originated in Mexico. The entire gene sequence was analysed for risk assessment. Haemagglutinin gene of this novel virus was derived from North American swine viruses, and, on the other hand, the neuraminidase gene was derived from Eurasian swine virus. Pigs would not fly over oceans. Then where were these viruses mixed? It is still a big question. Genetic relationship among avian, swine and human viruses is very similar. The swine virus had an intermediate type of mixture of human and avian type, about half of the amino acids were changed from avian type to human type, but it still had several characteristics of avian type (Fig. 2).

Pandemic (H1N1) 2009 virus is not fully adapted to humans yet. The amino acid is also somewhat different from Spanish flu viruses. The novel H1N1 virus, the pandemic virus, is an intermediate of Spanish flu virus and seasonal Russian virus. The receptor-binding specificity of this current virus is retained both in avian type and human type and it is combined to both. Antigenically it is very homogenous and genetically also it is very homogenous. In April 2009, an expert group concluded that this virus was typically a low pathogenic virus. The risk assessment is that the current virus is essentially sensitive to neuraminidase inhibitor drugs. Older people born before 1947 have been exposed to Spanish flu-like viruses and have acquired highly cross-reactive immunity against the current H1N1 pandemic virus. In addition, many people in younger generations have also some cross-reactive immunity which is primed by seasonal H1N1 viruses. There is no difference between the fatal cases and the mild cases at the genetic or molecular levels, although D222G amino acid change in haemagglutinin (HA) protein is often found in the fatal cases. However, these mutants did not spread further (Table 1).

There are at least two genes that are responsible for jumping over the species barrier from avian to human. On the other hand, there are genes that are responsible for highly pathogenic properties. Genes responsible for species barrier are differently located from the genes that are determining the highly

Fig. 2: Amino acid substitutions in HA occurred much less in H1N1pdm virus than seasonal H1N1 viruses. Therefore, H1N1pdm virus is antigenically similar to Spanish flu virus

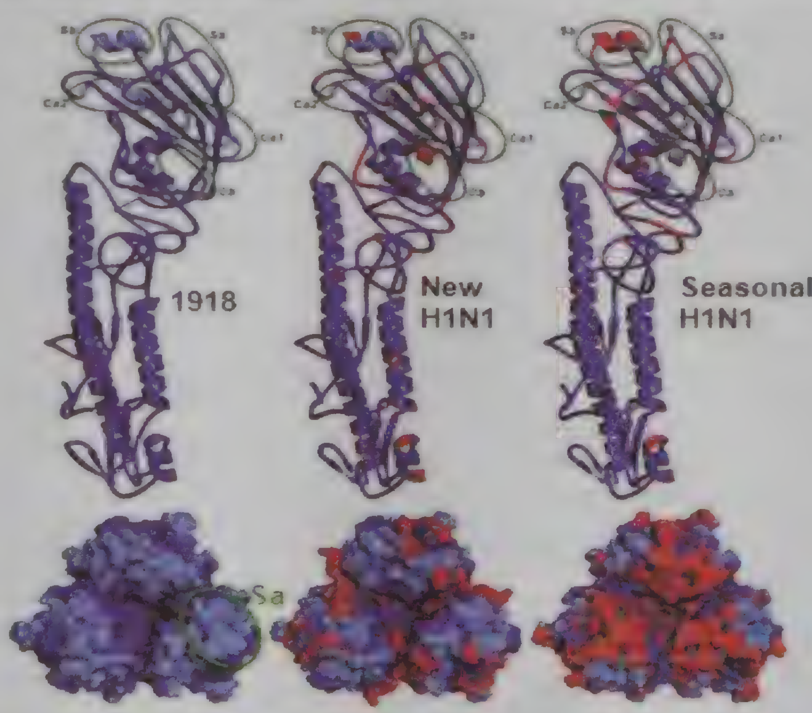


Table 1: Virological findings of H1N1pdm

• Virological findings are substantially consistent with epidemiological and clinical pictures.
• A(H1N1)pdm virus is not well adapted to humans yet, and may become more adapted in the future.
• No pathogenic marker of H5N1.
• No difference in virus characteristics between severe/fatal and mild cases, while viruses with D222G mutation were detected in some fatal cases.
• Susceptible to neuraminidase inhibitors.
• Most people had acquired cross-protective immunity against H1N1pdm virus through exposure to seasonal H1N1 viruses.

pathogenic properties. The possibility of emergence of a highly pathogenic human virus is a big issue for the pandemic. For adaptation to humans two factors have been identified (Table 2).

The haemagglutinin (HA) protein of influenza virus binds to target cells. For, the avian virus specific receptors comprise sialic acid α2,3 galactose (SA α (2-3)Gal), which distribute in bird tissues, whereas human virus binds preferentially to sialic acid α2,6 galactose (SA α(2-6)Gal) sugar chains present in mammalian bodies. Avian viruses will infect preferentially bird species and will not infect humans efficiently. However, this barrier is not absolute, and indeed H5N1 infects humans even less efficiently. One amino acid substitution, due to a gene mutation at the receptor binding site of HA to the human virus type, changes the receptor preference and determines the change of the host range. For H5N1 avian virus to become a human type, such a mutation is likely required.

Table 2: Possibility of the emergence of an H5 highly pathogenic human virus?
(A worst-case scenario of pandemic)

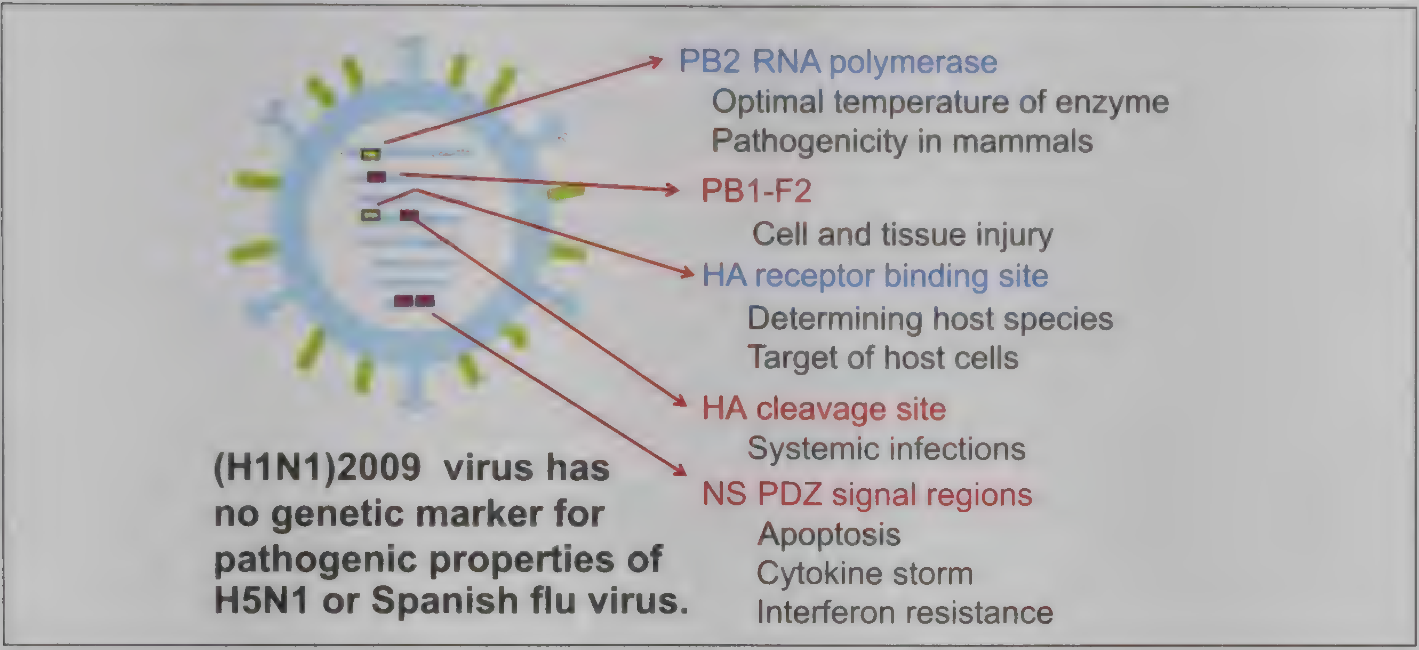
- Adaptation to humans across species barriers
  1. Receptor specificity; $\alpha(2–3)$ to $\alpha(2–6)$
  2. Polymerase complex;
     Optimal temperature; 42 °C to 36 °C
     Host cell co-factors.
- Retaining of the highly pathogenic properties
  1. Systemic infections;
     Wide distribution of receptor in a host;
     HA cleavage site vs host proteases.
  2. Cytokine storm inducing;
     NS1; type 1 IFN and TNFα antagonist
     PB2; pathogenicity in pigs and mice
     PB1-F2; tissue injury, bacterial super-infection.

Several factors determining the highly pathogenic properties of H5N1 have been identified. The most important is the basic cleavage site of HA. The precursor HA molecule synthesized in infected cells is non-active and the progeny virus remains non-infectious and further transmission or further replication will not occur. When the protein is cleaved or split by host protease, the virus becomes infectious and further multiple cycles of replication are permitted. Highly pathogenic viruses possess a cluster of basic amino acids at the HA cleavage site, which is cleaved by a ubiquitous protease present in all cell types, whereas the cleavage site of low pathogenic viruses consists of a single arginine residue, which is cleaved only by specific proteases present in the respiratory organs. Progeny viruses of the highly pathogenic virus in all organs are infectious while those of low pathogenic virus are infectious only in respiratory and alimentary organs. This difference determines that highly pathogenic H5N1 causes systemic infections while infections by low pathogenic viruses, including seasonal human influenza viruses, remain localized in the respiratory and alimentary tracts.

Other additional factors are also reported for the pathogenic properties. Only a few amino acid changes N66S in PB1-F2, E627K in PB2, F92E/D, A149V or the C-terminus PDZ signal domain in NS1 will enhance the pathogenic property such as inducing of apoptotic cell deaths, interferon resistance and cytokine storm resulting in multi-organ failure and secondary bacterial infection. The second factor of highly pathogenic property of H5N1 is the cytokine storm inducing the hyper reaction of host responses resulting in multiple organ failure. H5N1 is revealed to possess all of the factors determining the pathogenicity (Fig.3).

The factors responsible for the adaptation of avian virus to humans across species barriers are specific. Recently, it was found that the H5N1 virus had mutated to bind human receptors more efficiently than avian receptors especially. The Clade 2.2 viruses circulating in eastern Asian countries including China, Turkey, Europe and Africa have acquired human-type receptor specificity. Some H5N1 viruses so far isolated from humans in different clades also have this change in the receptor-binding site. Originally, H5N1 virus had specificity to bind to avian virus but in some avian viruses, amino acid replacement has occurred to fit more to human receptors. The second factor for the adaptation of avian virus to humans is at the optimal temperature for replication. Amino acid exchange from E to K at 627 or D to N at 701 is responsible for the change to optimal temperature to fit into humans. Currently, this virus has this mutation for more efficient replication in humans at a lower temperature.

Fig. 3: Genetic determinants of H5N1 HPAI virus genes for host species and pathogenicity



Besides these two factors, there are only about 30 amino acid differences in human viruses and avian viruses. The amino acid residues of Spanish flu virus showed that about half of these amino acids remained avian type and the other half had changed to human type. The virus was highly adapted to humans, causing a devastating pandemic 90 years ago. At the most, half of the mutations are required for avian virus, including H5N1, to adapt to human types. The H5N1 viruses isolated from avian species are completely avian type. But some viruses isolated from humans have changed some of the 30 amino acids to human type. These mutations are now accumulating in all genes.

The current avian H5N1 is a particular influenza virus of avian type. Some mutations are required for the virus to adapt to human type, but such mutations have occurred, threatening the worst case scenario of devastation by H5N1 virus. There is an increasing risk of H5N1 virus to change to human virus; this is the current molecular epidemiological thinking.

The National Influenza Centre in China and other groups reported that H5N1 virus was identified in many different organs of its human victims. RT-PCR was positive for H5N1; the RNA and viral proteins were detected in the infected cells of not only the respiratory organs but also in the brains, alimentary and urinary tracts and lymphatic tissues. In pregnant women, the virus infection was also documented in the placenta and foetal tissues. That means the virus has virtually replicated in the cells and H5N1 causes a systemic infection; these findings are quite different from the seasonal influenza infections including the pandemic H1N1. The laboratory tests indicate the resulting multiple organ failure.

Among humans, H5N1 is an emerging severe infectious disease. The pathological features are of severe pneumonia, systemic infections and cytokine storm, resulting in multiple organ failures, mainly affecting children and young adults, and the case-fatality rate is more than 60%. In Indonesia, without any treatment, the mortality rate has been 100%. This clinical picture, epidemiological evidence and the findings are quite different from the seasonal influenza. The seasonal influenza virus infection remains localized in the respiratory tract and causes influenza-like illness and claims victims mainly in the high-risk groups (Table 3).

When H5N1 becomes a human-type virus with pandemic potential, there is a possibility of retaining the highly pathogenic property of H5N1 in human virus because the pathogenic determinant is different from that responsible for the jumping over of the species barrier. The systemic infection is determined by haemagglutinin gene and the cytokine storm is determined by several multiple genes.

Table 3: H5N1 human cases

• Severe pneumonia and systemic infection Virus replicates efficiently in the lungs and invades blood stream, spreading to various organs • Cytokine storm Over-reaction of host defence mechanisms, resulting in multi-organ failure • High case-mortality rate (>60%) in children and young adults • Different from seasonal influenza • Virus infection restricted to respiratory organs • ILI • Fatality rate <0.1% in high-risk groups

The hemagglutinin gene cleavage site of the highly pathogenic viruses consists of a cluster of multiple basic amino acids, R and K. On the other hand, in low pathogenic viruses including seasonal influenza virus, this cleavage consists of a single R residue. The protease responsible for the cleavage of this site for seasonal influenza virus is exclusively present in the respiratory tract. On the other hand, the protease which can cleave multiple basic cleavage sites exists in all organs; thus, all cells permit this highly pathogenic virus to cause systemic infection. It is proved in the chicken, which gives exactly the same picture that applies to humans.

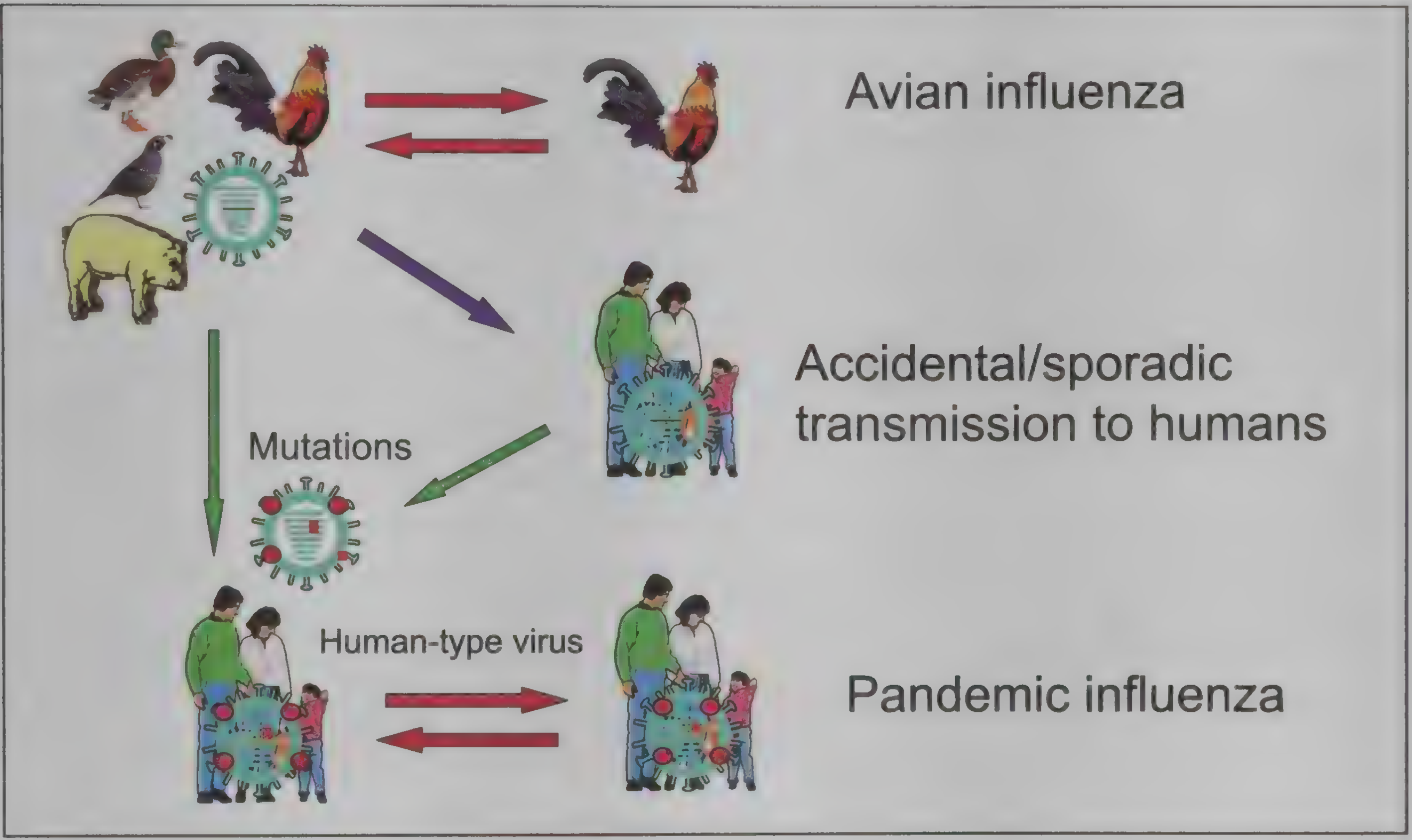
In all current H5N1 viruses, the cleavage site is always shown to have highly pathogenic properties causing systemic infection. The determinants for cytokine storm are determined by at least either of three different genes. H5N1 virus had acquired these changes. When pandemic virus occurs by accumulation of gene mutations without gene re-assortment, these determinants must be retained by the virus because the change of the species will not influence these genes responsible for highly pathogenic properties. The pandemic influenza so far explained in the 20th century, as well as the current H1N1 viruses, are derived from low pathogenic avian influenza viruses. However, the virus of H5 pandemic derived from the highly pathogenic avian influenza is likely to cause a systemic infection. The clinical picture will be quite different from the seasonal influenza or pandemic H1N1 influenza seen so far. According to the US pandemic plan, the pandemic caused by highly pathogenic viruses such as H5N1 will be much worse than the Spanish flu.

The second specific characteristic that is of interest to public health is the drug resistance. The drug resistance to adamantine is determined by the single amino acid mutation in M2 gene. This mutation is being monitored. On the other hand, drug-specific resistance for neuraminidase inhibitors occurs in different places. For the resistance of N1 subtype, H275Y amino acid change in the neuraminidase is responsible. The sensitivity of current pandemic viruses is being looked into. About 300 resistant (H1N1) 2009 pandemic viruses have been reported worldwide since April 2009. They occurred sporadically and clustering or further transmission has not been documented. .

Haemagglutinin gene divergence of H5N1 viruses are known since 1996. According to this divergence in genetic background, the antigenicity of these viruses has also become variable. It has ten genetic clades. The specific characteristic of interest to public health is the pandemic potential. Influenza pandemics have occurred at least six times in 120 years. Most of these viruses were derived from avian species. Currently, in the natural setting, H5, H9 and H7 are more prevalent among birds. The risk assessment of the emergence of a pandemic influenza needs to be done for H5, H9, H7 and

H6. H5 is now the epidemic in birds. In China and Indonesia, this virus was also found in pigs, and human cases have also occurred. Human pathogenicity is extremely high as the receptor specificity and optimal temperature has changed to human type. The pandemic risk is rather high, and if it occurs, its burden and social impact will be extremely high. On the other hand, H9 and H2, which are low pathogenic viruses, may cause a pandemic similar to H1N1. On the other hand, H2N2 was the pandemic virus and seasonal influenza virus from 1957 to 1968. This virus has disappeared but it is still stored in most laboratories. By some accident, it may spread from laboratory to people, especially young people who have no immunity to this virus which is 100% adapted to humans. It may cause a devastating pandemic similar to the flu virus of 1957.

Fig. 4: From avian flu to human pandemic virus



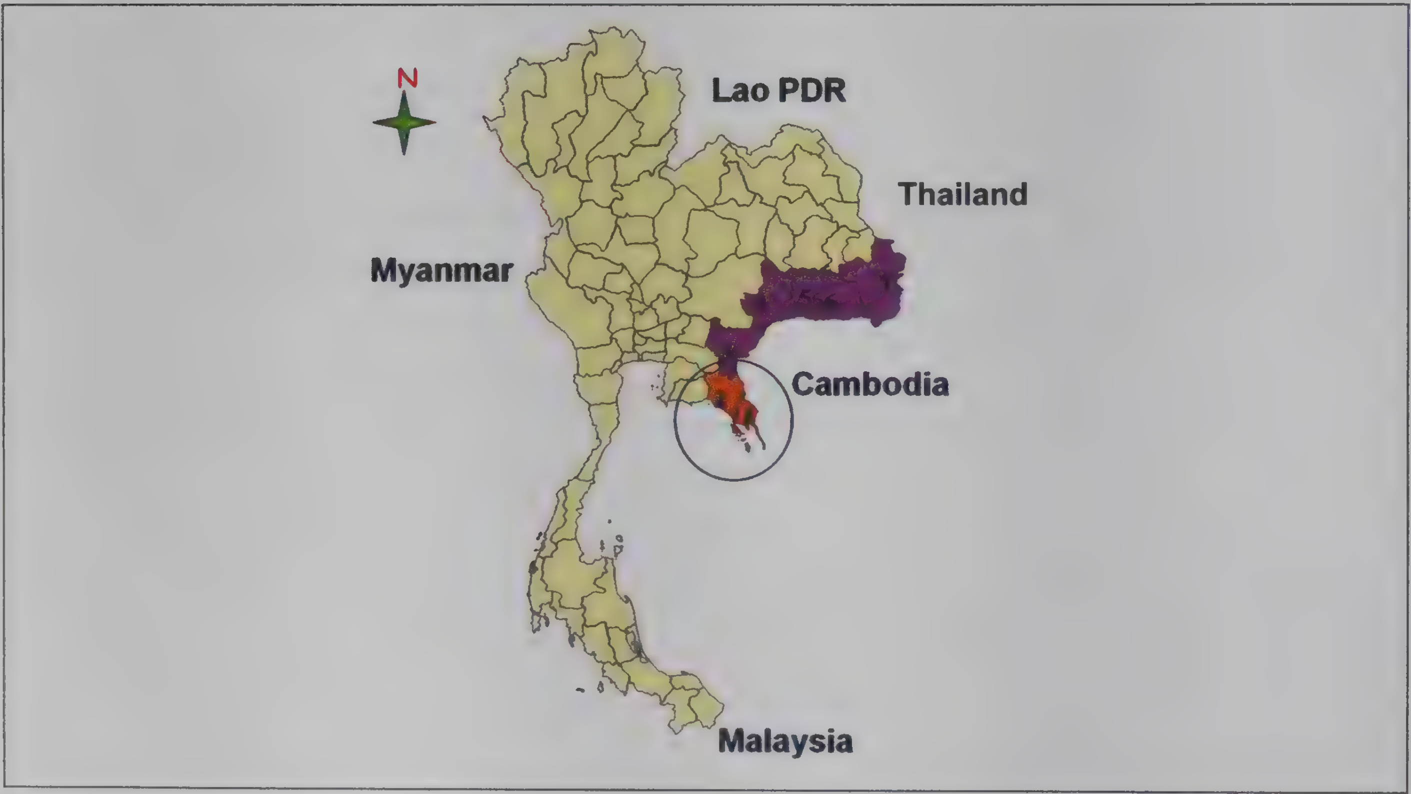
The H5N1 pandemic is still continuing in poultry and wild birds in Asia and Africa, and human cases have exceeded the previous year's number. One should not forget the potential pandemic of H5N1 which has pathogenic avian influenza-derived properties (Fig.4). During the H1N1 pandemic, H5N1 continued to settle and cause human infections. A possible gene reaction between H5N1 and current pandemic viruses may occur in pigs or humans. Hence, the risk of H5N1 pandemic still remains, which may cause more disease and social disruption. Therefore, countries should stay alert against the worst case scenario of pandemic influenza caused by H5N1 virus.

Application of GIS in monitoring drug resistance

Pratap Singhasivanon

In most countries of south-east Asia, malaria is an important public health problem. A lot of malaria drug resistance has emerged in areas along the Thai-Cambodian border since the late 1960s and 1970s. This area is an epicentre where resistance to chloroquine, sulphadoxin, pyrimethamine, mefloquine and some other drugs has been observed. There is evidence that this area may also be showing some tolerance and also resistance to artemesinin base. There is a prolongation of parasite clearance time; usually it is 48 hours to just above 48 hours but now it is prolonged to even three to four and even five days. In the Thai-Cambodian border area, only 35% of the patients clear the parasites at 72 hours. It is a matter of serious regional and global concern in that if there is resistance to artemesinin, then there will not be an alternative treatment for drug-resistant malaria. Hence, the World Health Organization (WHO) has initiated a project with the support of the Bill & Melinda Gates Foundation to track all malaria drug-resistant cases by developing a system where information is available in real time. Data can be collected at the field level and shared with many people at the same time. This project will follow all drug-resistant malaria cases and will also track migrants who move across the border. Some are hidden illegal workers and some frequently mobile and hard-to-reach populations. It is quite a difficult task; hence, a technology was needed for application at the local level at an affordable cost.

Fig. 1: Project coverage area



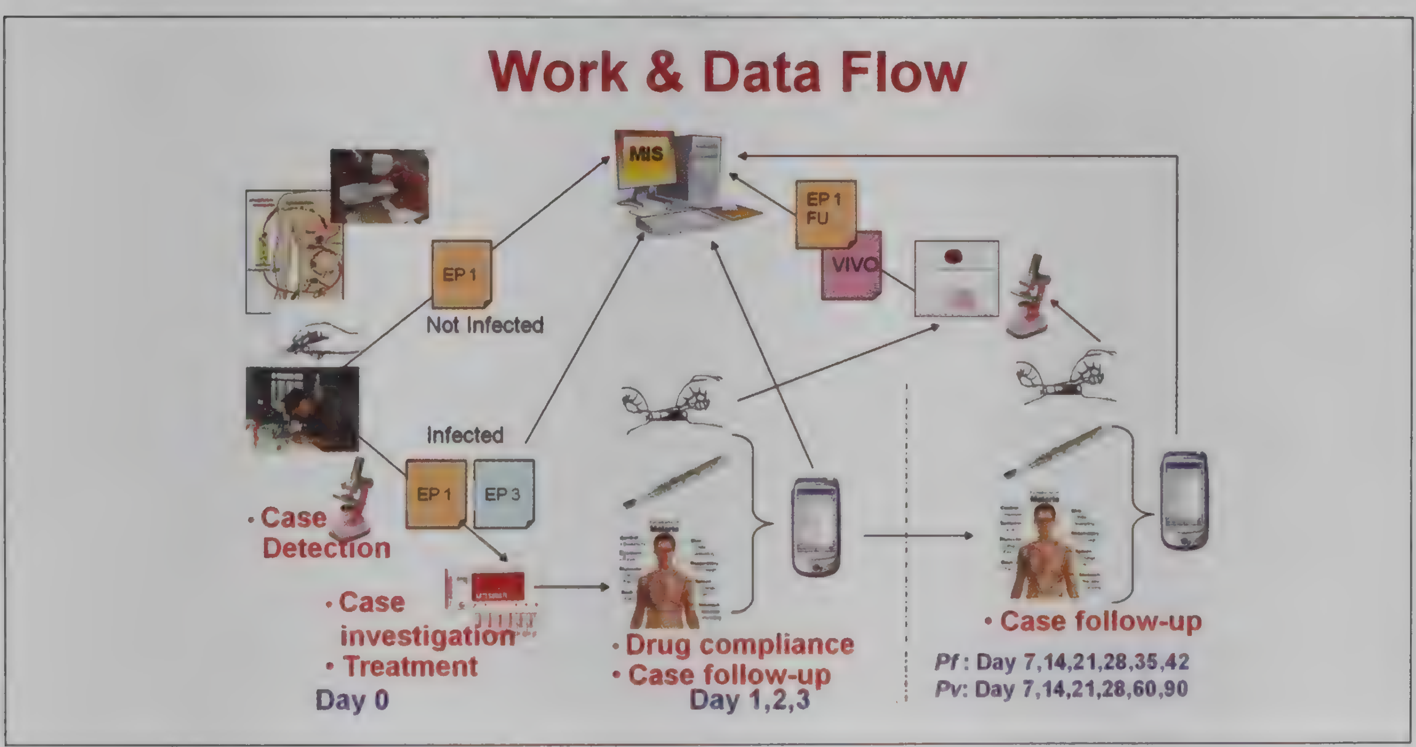
Scope

In the project area, there are seven provinces along the Thai-Cambodian border. In province numbers 1 and 2, monitoring is done at the household level, and in province numbers 3, 4, 5, 6 and 7, monitoring is done at the village level. The project contains over 11 000 villages and 12 000 hamlets, which are covered for the study using the vector-borne disease infrastructure of Thailand. There are malaria posts, malaria clinics, vector-borne disease units and vector-borne disease centres. All these layers are included in the surveillance system.

Malaria information system work flow

The original malaria paper-based work flow is used as a baseline concept in developing malaria information system (MIS). The MIS has cut off repetitive data entry work flow as well as added on new features for malaria case management. The MIS, however, was designed not to increase the workload of staff working at the point of care location. Currently, the new MIS system is based at the malaria clinic level. The information flows very quickly and timely. The forms that were used regularly have been transformed into digital formats for case detection, case investigation and laboratory information. For example, once a case is positive, case investigation is done and, after that, follow-up is done for drug compliance because the treatment is given for three days. Smart phone or mobile technology is used to do the follow-up and to record all signs and symptoms. The information flows from the field to different levels.

Fig. 2: System work flow

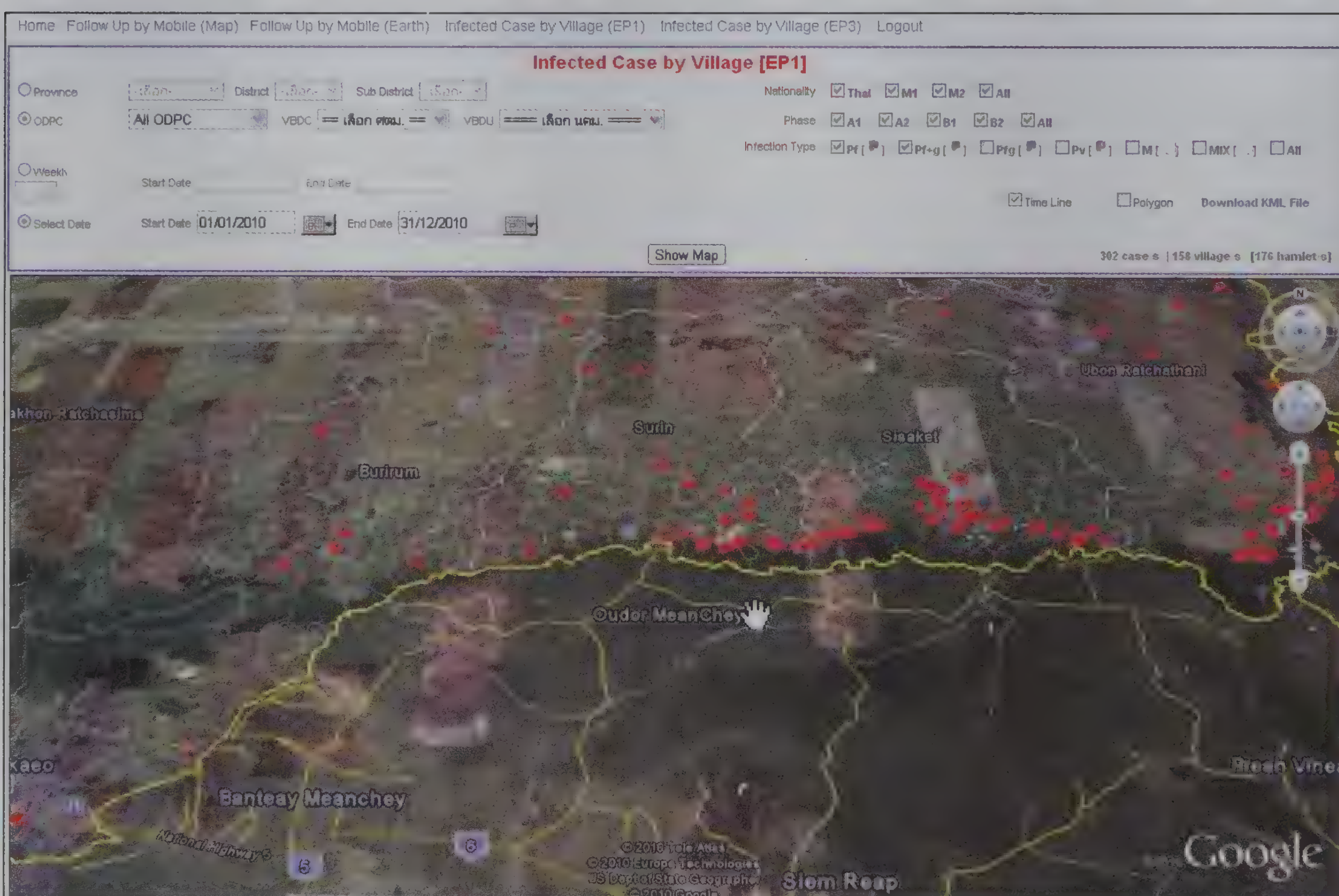


MIS features

The malaria health workers are very important in case investigation and case follow- up. They have to go to the field every day to take the blood smear of the positive cases for microscopic test and PCR. During home visit, they will be taking the blood smear, the temperature, and then using the mobile phone designed for collecting patient signs and symptoms. If the staff is in the area where there is a telephone signal, he/she can upload data into the server directly, but if there is no signal, the information stays in the application and can be later uploaded once he/she is back at the malaria centre.

In Chantaburi and Trad provinces, all important infrastructural needs have been met. All households in the transmission area have been covered. Pictures of all houses have been taken through the smart phone with permission from the owners. All houses are being photographed because some of the migrants stay in certain houses while they are working in that particular area. A detailed mapping and tracking of all information in both the provinces has been done. Systems have been set up at different levels, including at the sites, i.e. the malaria clinics. If there is an Internet connection, all the information that is required can be entered there. This system is working without any problem. In this system one can see the number of slides made, the number of cases and other details of the laboratory. Just a click on the map can show all the cases displayed by village or by household. The interaction with different areas can be seen, i.e. whether it is for Thai workers or for migrants who stay for more than six months or less or those who bring infections. Information can be displayed easily according to the stratification format. The MIS system and data/information collected in this system are treated according to standard public health practice. Only those who are authorized can access and make use of this system for the purpose of disease prevention and control in the respective communities for which they are responsible.

Fig. 3: Real-time map of all malaria-infected cases displayed at village level

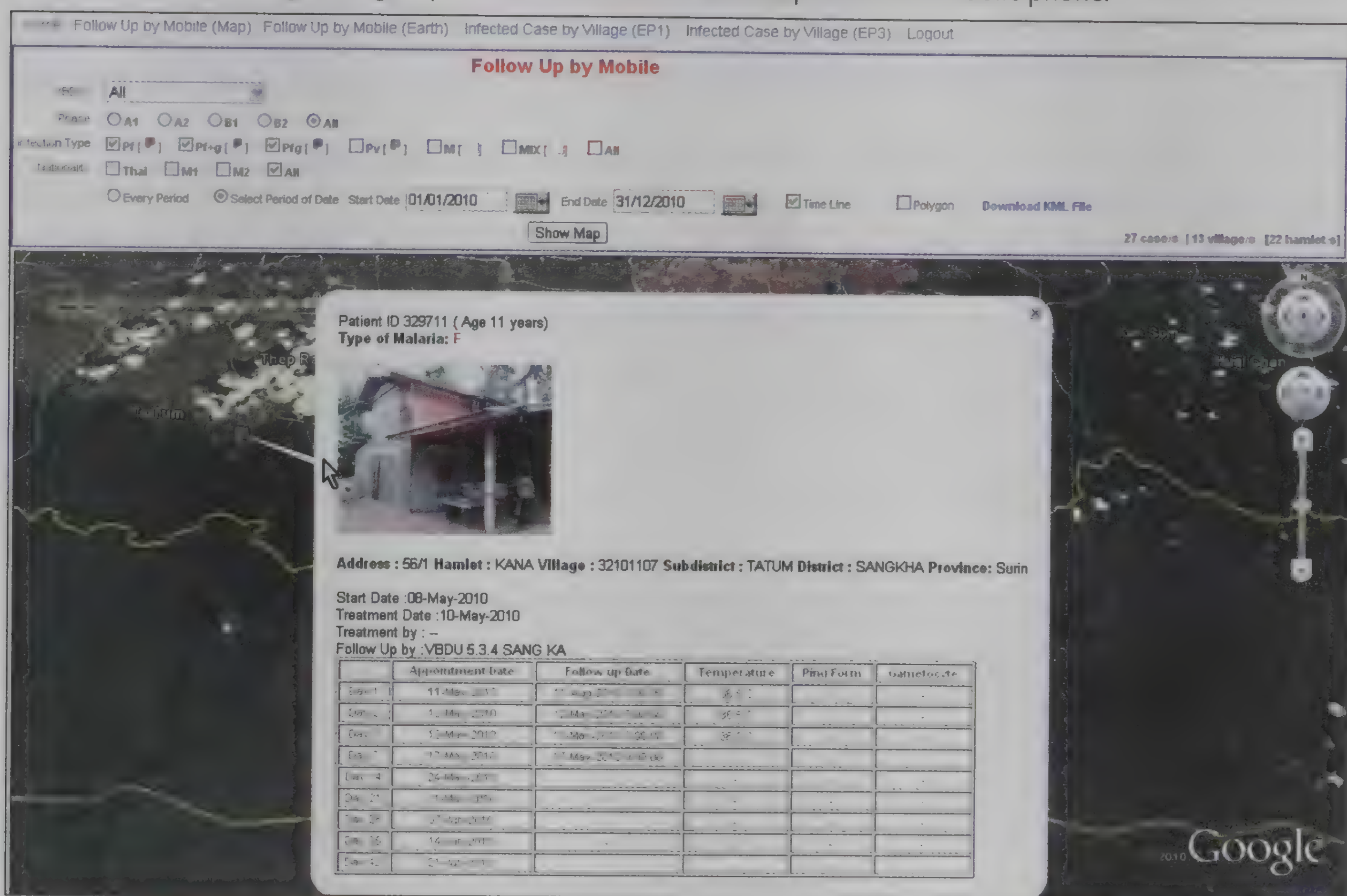


In the web-based Geographic Information System (GIS), the health worker can open the Internet in the morning. On the screen, they have to enter their password to log in for using the system. The system can show up who are to be followed up that day and where the cases are. They can look at the map displaying information of the infected cases at the household level or village level. The information shown by the house icons or the flags will indicate where the cases are occurring. With the spatial-temporal presentation of the system, one can zoom in to look at the incidence over time; one can see the case number that occurred at that particular spot and at a particular time. The staff can make queries to zoom in at a very detailed level to examine specific risk groups. One can trace

every single case very easily by clicking at any particular household to retrieve patient information. The local health- care provider can see how many times the patient's blood has been taken, what was the blood drawn date and when it was taken the last time. This is real-time information. With the information registered in the system, the responsible staff can identify what type of patients they are - Thai or migrants. After providing the treatment, the staff can use the follow-up module to follow the patients for the next 42 days for *P. falciparum* malaria and 90 days for *P. vivax* malaria.

There are two groups, the Thai and the migrants, who come from across the border. The migrants need to be traced because a lot of drug-resistant cases occur among them. That is why each case is important not only in the field but also in hospital. All the patients in hospitals are also being captured and recorded. GIS has information at the household level and also from hospitals. For the purpose of patient identification, the volunteer's picture may be taken with permission; the mobile itself can also record the GPS locations of new huts in a new area.

Fig. 4: Flag* represents household location captured from mobile phone.

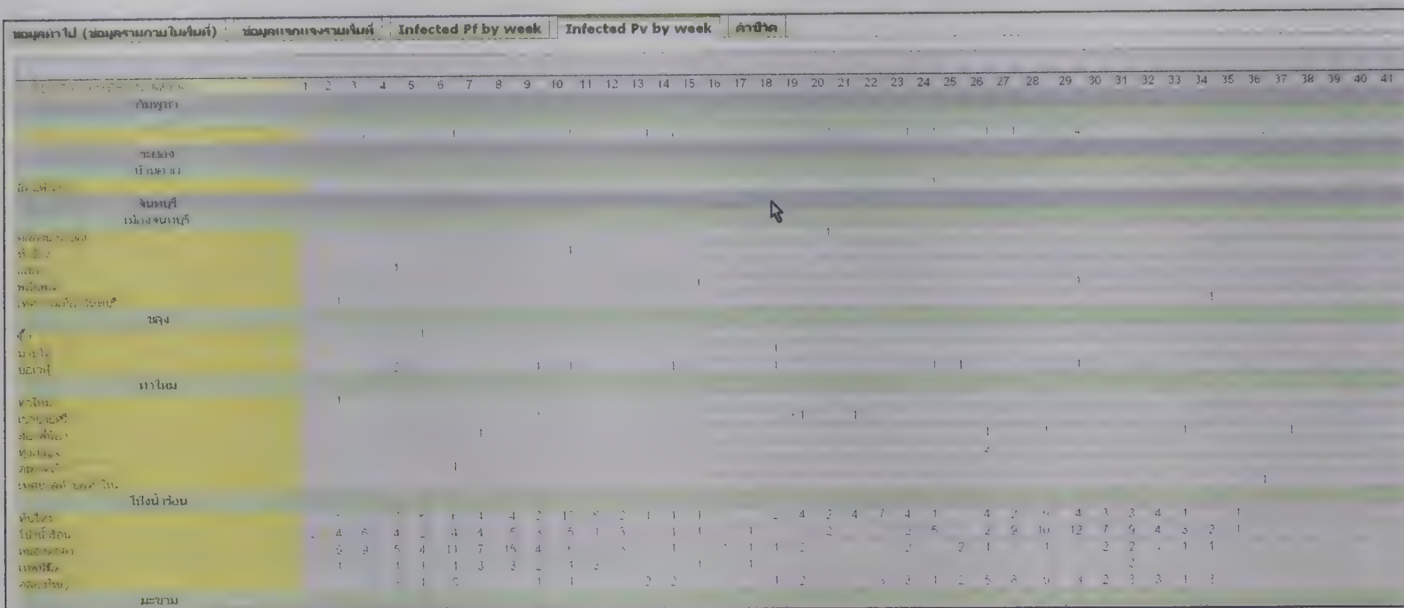


*Each flag can be selected for examining any visit made for follow-up

User inputs and utilization

The local malaria staff who have used the system are satisfied with this system because they do not have to re-analyse the information. Most of them reported that this online system is quite satisfactory as it can summarize the information as soon as it is entered. They can see what happened in their area as well as in the adjacent district or province. The vector-borne disease unit in this particular area said that they can monitor the situation in their responsible areas and can take decisions based on the information in the system. The summary statistics and GIS presentations make it easier for them to plan their actions.

Fig. 5: Infected cases *(P.falciparum/P.vivax)* are generated on a weekly basis, classified by district/subdistrict. Management can easily evaluate how well they can control the disease



An analysis module will be added to the system this year. Many functions, in the MIS are now available for local staff for daily use and more can be developed to detect the hot spot and do analysis of clustering of cases. The malaria staff can now go to the field or work in the malaria clinic with immediate access to individual or group data. Getting familiar with and recognizing the importance of evidence-based data for use in MIS as a daily disease prevention and control measure is crucial for the success of MIS implementation. Therefore, a large number of staff in the project area has been trained to use this information system.

Conclusion

To summarize, the GIS mobile technology is available and it is working. It is possible to have real-time information not only for malaria but also for other diseases that require regular, relevant and timely information in addition to accuracy. As shown by the real-world application, the GIS and mobile technology is being used to track all malaria-resistant cases quite effectively along the Thai-Cambodia border, with the hope that it will be possible to contain the spread of resistance to artemesinin, which may otherwise spread across the world.

The future of epidemiology: how is our science changing?*

Ann Marie Kimball, Cyan R. James and Danny Colombara

The boundaries of epidemiology are shifting. The past decades ushered in unprecedented technological growth that led to innovations in communications and computation. Each of these elements has its place in epidemiology and the combined effect has revolutionized the field. For example, advanced mobile telephony has brought public health communications to the remotest parts of the globe; communications technology can now pinpoint the geographical position of any person or event. Simultaneously, computational power permits an ever-increasing amount of statistical analysis and disease transmission modelling. This paper highlights four areas where epidemiology and public health practice seem to be headed: (1) enhanced visualization and event mapping; (2) increased emphasis on the 'social contract' of disease reporting and public welfare; (3) increased use of 'network analysis' as an integral companion discipline to field epidemiology; and (4) improved metrics for 'upstream' variables in the globalization of infections and other conditions. While it is hard to imagine what epidemiological innovations will emerge in the next 20 years, it is even more difficult to imagine the field remaining static, given the technological explosion of the past 20 years.

Ever since John Snow removed the handle of the Broad Street pump, epidemiology has been evolving. Though born in the field, it now encompasses more formal scientific and analytical studies, including case-control and cohort and clinical trials. The rapid technological changes of the past three decades promise to greatly expand the scope of epidemiology. Computing capabilities, visualization and mapping techniques and communications have all introduced new frontiers for the pioneering epidemiologist. To capitalize on these advances, epidemiology's boundaries are shifting. This paper discusses the drivers of change in epidemiology due to both technological advances and the novel health problems the discipline is now being called upon to address.

A white literature search was run to survey published work on the future of epidemiology. The key phrases used, combining 'epidemiology' and 'future', as well as the subtopics 'innovation', 'networks', 'technology', 'computing', and 'information', indicate changes are afoot. Additionally, out of the 262 graduate students in the Master's and Ph.D. programmes in epidemiology at the University of Washington, 41 students who responded to a short poll perceive the need for increasingly complex epidemiological analysis.

Global health problems have become more complex. Social and economic factors are increasingly cited as health status determinants. Factors such as climate change, global trade and travel and microbial evolution continuously precipitate the emergence and dissemination of new human pathogens, most of which have zoonotic origins. Human health is thus increasingly ascribed to the ecology within which humans exist, from the macro level of climate change to the micro level of pathogen emergence. Some authors refer to this concept as 'eco-epidemiology' *(1,2,3)* while others use the term 'multilevel

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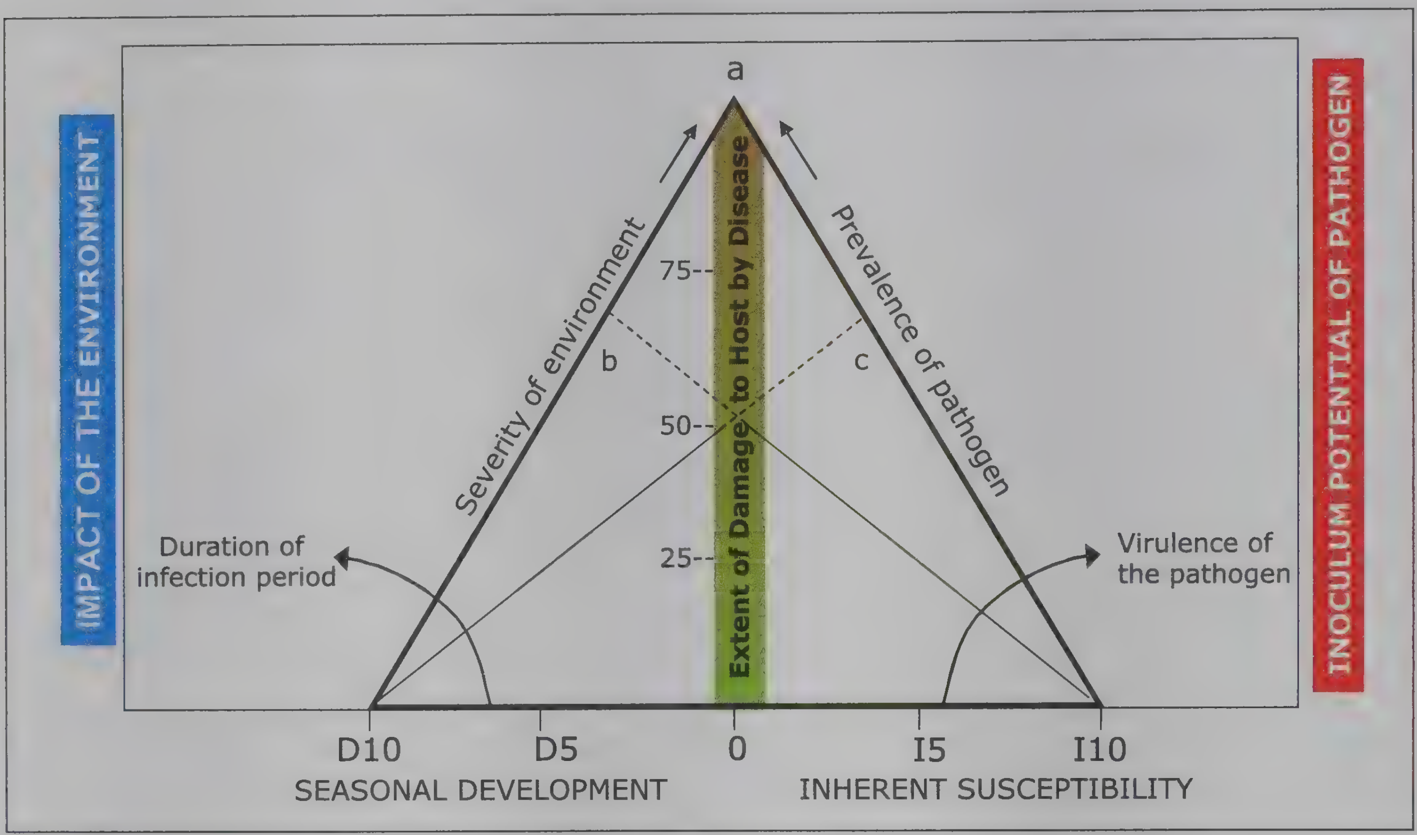
epidemiology' *(4)*. Regardless of terminology, this emerging concept of epidemiology is expected to provide a more integrated framework for complex systems analysis.

Epidemiology, "the study of what is upon the people" (from Greek), is defined as "the field of medicine concerned with determining causes, incidence and characteristic behaviour of disease outbreaks affecting human populations. It includes the interrelationships of host, agent and environment as related to the distribution and control of disease" *(5)*. Increasingly, the environmental aspect of this interrelated model challenges our science. Epidemiological inference to inform public health policy depends on our ability to understand and apply meaningful metrics to the 'environment' in the disease triangle *(6)* (Fig.).

Fig. 1: The disease triangle



The disease triangle drawing is closely based on the one described by McNew (1960)[1] including the pertinent parts of his figure legend: "The triangle of factors that limit an epidemic. The full impact of a pathogen may be avoided either by reducing the host susceptibility, inoculum potential of the parasite, or environmental conditions favorable to pathogenesis. The peak may be reduced from a maximum point [here, as "a", which is the economic effect of the disease in a host] to some lower level [shown here as "b" and "c"] … restricting the factors in an epidemic…would reduce disease from a maximum of 100 to some lower figure [such as 50, as shown in this diagram]. All figures are assigned empirically and cannot be given precise values at this stage of knowledge. The preferred treatment for a disease shifts progressively clockwise from the left corner to the lower right side of the base as the specialization in pathogenesis increases [from moderate to severe disease]." Determinants that affect host outcome include seasonal development (D) and inherent susceptibility (I). It is also important to note that temporal effects are implied for each factor related to McNew's disease triangle.

Our graduate student respondents also perceived the need for increasingly complex epidemiological analysis. The response was modest (n=41) but instructive, as shown in Table.:

[1] McNew GL. The nature, origin, and evolution of parasitism. In: Horsfall JG & Dimond AE (eds). Plant Pathology: An Advanced Treatise. New York, Academic Press, 1960, 19-69.

Table: Quick poll of epidemiology graduate students, 2010

Question: Please pick (check the box) the top five areas which will be the most important innovations in epidemiology (in your opinion) in ten years.

Areas	Frequency	Percentage
Increased reliance on modelling informed by empirical data	30	73.2
Increased incorporation of social sciences (anthropology, sociology, political science) into formal epidemiological analyses	25	61.0
Increased ethical emphasis and inclusion of community participation in study designs	16	39.0
Diversified sources of support with increasing support from private sources	18	43.9
Enhanced data-sharing by all stakeholders	32	78.1
Incorporation of fractal or other 'non-normal distribution' statistical techniques	6	14.6
Emergence of media celebrities as spokespeople for epidemiology and public health	3	7.3
Standardization of climate variables in epidemiological research	10	24.4
Wearable computers and/or sensors for exposure verification	18	43.9
Incorporation of network and complex system analyses into epidemiology	27	65.8
None of the above	1	2.4

As shown above, most responding students believed there will be enhanced data- sharing by all stakeholders, and anticipated increased emphasis on modelling with empirical information, complex systems analysis and social science inclusion over the next 10 years. In other words, they anticipated a more integrated framework to allow multilevel investigations of risks and disease occurrence.

Enhanced visualization techniques and innovative Geographic Information System (GIS) technologies promise to revolutionize the concept of 'place' in disease risk, occurrence and prevention. For example, simple Geographic Positioning System (GPS) devices have already made the systematic inclusion of exact geographical location possible for field work. In the last decade alone, the capacity to competently localize and visualize events has been accompanied by innovations in spatial epidemiological techniques (such as smoothing techniques). Computer-aided visualization tools are now routinely used to track disease outbreaks worldwide. Visual analytics is a relatively new field which seeks to systematically use such visualizations for analysis and inference *(7)*. It is likely that epidemiologists will find this new science useful in their future work.

Assurance of data and information access will increasingly rely on the implicit 'social contract' of epidemiological study. Compliance with study protocols as subjects, sharing of data among collaborators and disclosure of risk-factor information in individual studies – all hinge on the assurance that the work is being done to improve health. This social contract will become more central and is likely to become more explicit as greater volumes of information are investigated.

Our students felt that complex systems analyses such as network analyses would become more important to the future science of epidemiology. This is borne out in the literature as cited above. Networks are increasingly investigated in public health and an excellent summary of this work is provided in a recent review *(8)*. The review authors summarize the uniqueness of this approach,

"Network approaches focus on relationships between subjects rather than relationships between subject attributes (i.e. variables)." Clearly, in our interconnected world, appreciation of exposure modification through linkages will become more central to our epidemiological understanding of disease.

However, for many current 'factors' which are related to the emergence of disease in populations, metrics elude us. Metrics of climate change and metrics of mobility illustrate this difficulty. Climatology presents the epidemiologist with an enormous range of variables from which to choose. For example, is it temperature or humidity or both which impact exposure to influenza? Is transmission most profoundly impacted by absolute or by relative humidity *(9)*? When epidemiologists work 'back up the chain' of causation to outline potential intervention points, the definition of metrics of interest becomes even more problematic, as exemplified by the work done on the relationship of the hantavirus Four Corners outbreak to El Nino *(10),* vegetation and host populations, and similar work done on the Nipah virus outbreak's, relationship to anthropogenic deforestation and climate change *(11)*.

Mobility of populations and goods creates even greater measurement difficulties. While we know that 'air bridges' link distant, epidemiologically dissimilar locations and create the potential for bi-directional pathogen transfer, and that microbes can only cross oceans as travellers in hosts or fomites, we have yet to identify the most important metrics in measuring the potential population risk of travel and trade connections. Is it the number of passengers per unit time? The distance between locales? The endemic disease patterns or existence of potential vectors in destinations? How are 'populations at risk' to be measured when modern mobility is so complex and profound?

In sum, the future of epidemiology will be marked by increased interdisciplinarity and integration. The 'multilevel' or 'eco-epidemiological' approaches advocated for problem-solving are pushing epidemiologists into partnerships with scientists from other disciplines. More specifically, aspects of complex systems and visual analytics may be important to incorporate into the discipline to ensure that its robust problem-solving capacity continues to contribute to public health in the future.

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Towards universal childhood immunization: why we must do and how we might?

Stanley I. Music

In the summer of 1965, I was between my third and fourth years of medical school and found myself in the stunningly beautiful northern reaches of what was then West Pakistan. I was working at the University of Maryland's International Center for Medical Research and Training in Lahore, a city I had first 'visited' in the writings of Rudyard Kipling. However, I spent much of my time in the mountains north of Lahore helping to trap a variety of rodents, which were then carefully inspected for, and then stripped of, all trombiculid mites they happened to be carrying. The mites were then assessed to see if they were carrying the causative organism of scrub typhus, a rickettsial disease of some interest at the time.

I saw much during that summer that would profoundly affect me as a physician: rabies, plague, malaria, polio, cholera and smallpox, among other 'exotica', certainly, but also much that would affect me as a sentient fellow human: the poverty, the almost medieval therapeutics of the local economy, and – though I would have called it something else – the unfathomable chasm between their 'normal' and mine.

A recent newspaper article will serve as entrée to one specific aspect of this chasm, immunization, in rather concrete terms. Justin Gillis, in writing about the ambitious immunization initiatives of The Bill & Melinda Gates Foundation, states in part:

> "…In the United States and other rich countries, fewer than 1 percent of children die before reaching age 6 years, but in some poor countries that number exceeds 20 percent. Malnutrition and poor sanitation contribute enormously to the toll, but so too does the lack of basic immunizations. By World Health Organization estimates, 2.7 million children ages 5 and younger die every year of infectious diseases preventable with vaccines, many costing only pennies per dose…"[1]

So, how much has the immunization world actually progressed since 1965? Though real progress has certainly been made, much yet remains undone.

For starters, smallpox is gone.

What I mean by these words is that "natural" or wild-type smallpox disease has been successfully eradicated, and live variola virus is now supposed to exist only in two designated P-4 containment facilities. True, we must remain prudently mindful of and prepared for the horrific prospect of its potential reintroduction into circulation by bioterrorists. But, since some time in November 1977, the world has been free of the untold suffering, the scars, blindness and the many millions of premature deaths that accompanied its visitations for untold centuries.

Edward Jenner first published on vaccination in 1798, not a time in world history noted for the rapid communication of events and ideas. Yet, despite the controversy in England that quickly engulfed

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[1] With Gates' Help, Immunization Initiative Surges, article by Justin Gillis, *Washington Post*, 14 July 2003.

this discovery, it didn't take long for some non-British politicians to understand its implications and applications:

- Napoleon Bonaparte, Emperor and King of France, issued a medal only six years later, in 1804, publicizing the establishment of a Paris-based organization to promote vaccination, admonishing the French public to get vaccinated, informing that a major medical breakthrough had been achieved, and advising that they should avail themselves of it.
- Thomas Jefferson, President of the United States, wrote a letter to Jenner in 1806, focusing on the practical implications of vaccination, stating in part:

  "…Medicine has never before produced any single improvement of such utility. Harvey's discovery of the circulation of the blood was a beautiful addition to our knowledge of the animal economy, but on a review of the practice of medicine before and since that epoch, I do not see any great amelioration which has been derived from that discovery. You have erased from the calendar of human afflictions one of its greatest. Yours is the comfortable reflection that mankind can never forget that you have lived. Future nations will know by history only that the loathsome small-pox has existed and by you has been extirpated…"[2]

Yet, more than 150 years would pass before the vision expressed in Jefferson's hopeful and eventually prophetic words could be realized.

The eradication of smallpox was the wondrous result of a sustained global effort in the 1960s and '70s. It required and enjoyed unprecedented political will and international cooperation. Surprisingly, the establishment of a global smallpox eradication effort stemmed from a Soviet proposal, made at the very height of the cold war. And it was immediately and enthusiastically supported by the US, with Congress authorizing extra appropriations to make it happen.[3]

Soon, if we are lucky, the same fate could await polio, following through on the practical implications of the pioneering work in the 1950s by Jonas Salk and Albert Sabin:

> "…In 1959, Sabin attracted the most attention when the Soviet Union vaccinated its entire population, especially 10 million children under 15, with his vaccine and then offered to give it away to any country willing to accept it. By June 1960, Sabin's vaccine had been given to over 50 million people in the Soviet Union, China, Czechoslovakia, the US, Canada, Mexico, Singapore, Africa, the United Kingdom and various other European countries…"[4]

Fifty years for polio is certainly better than the 150 years that smallpox required.

The vaccine establishment has seen some encouraging events over the past few years, such as:

- real leadership from the UN, especially from the Secretary-General himself, and from the UN specialized agencies, WHO, UNICEF and the World Bank, and especially but not limited to the Global Alliance for Vaccines and Immunization (GAVI) and the Vaccine Fund;
- the remarkable efforts of The Bill & Melinda Gates Foundation;
- the growing global commitment to the development of rotavirus vaccines;
- global cooperation and unprecedented public transparency in response to the threat of severe acute respiratory syndrome (SARS).

Unhappily, though we have safe and effective vaccines against "the usual childhood diseases", it still appears that their actual use remains much less than optimal in many parts of the world. A quick perusal of the WHO website provides evidence of contemporaneous and disturbing under-use, as

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[2] From a letter to Dr. Edward Jenner on his discovery of the smallpox vaccine, May 14, 1806.

[3] Clearly, there are lessons here. This didn't "just happen" all by itself. It had to have been somehow orchestrated and coordinated behind the scenes.

[4] Accessed from an Aventis Pasteur website, http://www.polio-vaccine.com/us/index.html, July 12, 2003.

revealed by selections from the most recent annual morbidity and mortality data available (list is exemplary, not inclusive, of all vaccine preventable diseases):

- an estimated 745 000 children die of the complications of **measles** each year[5];
- 600 000 **tetanus** deaths, 126 000 (21%) of which are neonatal;
- an estimated 45 million cases of **pertussis** with approximately 409 000 deaths;
- invasive **Hib disease** (meningitis and pneumonia) still results in 400 000 – 700 000 child deaths annually
- WHO's conservative estimate for the **meningococcal meningitis** disease burden is 300 000 to 350 000 cases and more than 30 000 deaths per year;
- acute respiratory infections kill an estimated 2.6 million children less than five years of age annually; the **pneumococcus** causes over 1 million of these deaths, most of which occur in developing countries.

So, while the public is kept almost breathlessly informed of each new increment of progress in developing long-awaited vaccines against malaria, HIV, tuberculosis, rotavirus and human papillomavirus, the regrettable under-use of existing vaccines receives scant attention.

The following excerpts from especially poignant works by a Nigerian (Chinua Achebe) and a Ugandan (Okot p'Bitek) speak volumes about the conditions under which much of humanity lives even today in the 21st century:

> "…As I stood in one corner of that vast tumult waiting for the arrival of the Minister, I felt intense bitterness welling up in my mouth. Here were silly, ignorant villagers dancing themselves lame and waiting to blow off their gunpowder in honour of one of those who had started the country off down the slopes of inflation. I wished for a miracle, for a voice of thunder, to hush this ridiculous festival and tell the poor contemptible people one or two truths. But of course it would be quite useless. They were not only ignorant but cynical. Tell them that this man had used his position to enrich himself and they would ask you – as my father did – if you thought that a sensible man would spit out the juicy morsel that good fortune placed in his mouth…"[6]

"…And while the pythons of sickness
Swallow the children
And the buffalos of poverty
Knock the people down
And ignorance stands there
Like an elephant,
The war leaders,
Are tightly locked in bloody feuds
Eating each other's liver…"[7]

The vision that I have is of a different world, a world in which every child is appropriately vaccinated as per his/her age against the major killers mentioned above. While it remains an impossible dream to provide every household on earth with running water and sanitary waste disposal, the 'other' things

[5] We have had today's measles vaccine since 1978.
[6] From *A Man of the People* by Chinua Achebe, 1966.
[7] From *The Song of Lawino* by Okot p'Bitek, 1966.

that would most improve child survival, it is well within the reach of existing resources to assure the ongoing vaccination of all children everywhere.

In my view, this is a precondition – insufficient alone but absolutely necessary – for global economic development and a stable world. Despite the pioneering and heroic efforts to date of GAVI et al., immunization remains inadequately addressed. As I have seen and had it reinforced many times, the only "social security" that a third-world farmer has is to assure the birth of at least two sons who will survive to adulthood and provide sustenance when he is too old to work the fields. And the only way to assure the survival of two sons often translates into having as many as eight children. So, many children are a blessing when child mortality is high. Daughters marry and go away to live elsewhere, but sons stay at parental home to raise their own families. If child mortality is high, then fertility is stimulated to make up for the children who will die. Only when that farmer can reliably count on the survival of his children do many children become a burden to feed, and will fertility be constrained thereby.

As an interdependent global community we can neither afford nor tolerate the needless, counterproductive stimulus to high fertility that accompanies the already weighty burden of diseases that are preventable through vaccination. We also can't afford to continue the perpetuation and propagation of the disparities and social injustice that result from *not* doing this. Universal childhood immunization is in our own enlightened self-interest as human beings, like it or not.

Understandably, some of the champions of universal immunization have chosen to pursue this worthy and lofty goal as an inherent human right. The merits of a posture of entitlement are immediately obvious: in principle, all of the world's children could be age-appropriately immunized and vaccine-preventable diseases would essentially disappear.

Much less obvious, but equally potent, is an unintended consequence: the lethal effect that such entitlement would impose on the private sector vaccine research and development, on the incentives that stimulate creativity and inventiveness. Without resort to hyperbole, such entitlement could put at risk the intellectual property and trade secrets of private vaccine manufacturers, as these could become public goods. The vital role that the private sector vaccine development has played could cease to exist.

The foregoing is not a rhetorical ploy, a *reductio ad absurdum* construct. If universal vaccination were to become a human right, the entrepreneurial system that creates today's vaccines could itself become a victim alongside today's vaccine-preventable diseases.

The Universal Declaration of Human Rights (UDHR) and Article 12 of the International Covenant on Economic, Social and Cultural Rights (ICESCR) are interpreted by some as embodying a right to essential medicines. The selected text below can be seen as raising the question, "Are pharmaceuticals private goods to be obtained through the market, or are they public goods to which all citizens have a right?"

- Article 25 of the UDHR states in part,

  "Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services…"

- Article 12 of the ICESCR states in part,

  "1. The States Parties to the present Covenant recognize the right of everyone to the enjoyment of the highest attainable standard of physical and mental health.

  2. The steps to be taken by the States Parties to the present Covenant to achieve the full realization of this right shall include those necessary for:

a. The provision for the reduction of the stillbirth-rate and of infant mortality and for the healthy development of the child…

b. The prevention, treatment and control of epidemic, endemic, occupational and other diseases…

While emphatically supporting the above principles in the UDHR, the ICESC, and the related Global Compact, I also support the countervailing principles contained in the same documents:

- Article 27 of the UDHR states in part,

"(1) Everyone has the right freely to …share in scientific advancement and its benefits.

(2) Everyone has the right to the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author.

And in very similar words,

- Article 15 of the ICESCR states in part,

"1. The States Parties to the present Covenant recognize the right of everyone:…

a. To enjoy the benefits of scientific progress and its applications;

b. To benefit from the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author…"

I believe the dilemma thus posed is a false dichotomy between patients and patents, a dilemma that simply must be avoided, as it is antithetical to progress. And I think there is a better way, a path that has the potential to achieve universal immunization without also putting private enterprise and its benefits at risk. That path begins with couching universal immunization as a societal need, a kind of public utility instead of as an individual right.

Though I am not an economist, I did spend a year on a health sector assignment to the World Bank and thus have acquired a deeper appreciation of developmental economics than many of my medical peers. Market incentives do indeed support innovation as I have tried to indicate above, of that there can be no doubt. However, when and where markets fail (as is certainly the case in many of today's developing economies), some way needs to be found to ensure that vaccines – precious commercial goods for which there is no substitute – can be made available to those who simply cannot afford them. Through their visionary leaders and philanthropists, other nations and organizations must be encouraged and rewarded for stepping in to make this happen. A recent and quite elegant article by Rappuoli et al.[8] first makes the case for vaccination as an exceedingly highly-valued and under-appreciated enterprise, but then ends with the question "How do we mobilize governments in developing countries to be proactive?"

In his thoughtful meditation[9] on the distinction between *wants* and *needs* in the context of a welfare state, Michael Ignatieff argues that "We are responsible *for* each other but we are not responsible *to* each other…Modern welfare may not be generous by any standard other than a comparison with the nineteenth-century workhouse, but it does attempt to satisfy a wide range of basic needs for food, shelter, clothing, warmth and medical care."

I would argue that human society *needs* to have universal immunization achieved and maintained, because child survival is a necessary precondition to a stable human population and to economic development. I don't believe there is a shortcut. The demographic transition to lower fertility seems to first require a real demonstration of child survival.

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[8] The Intangible Value of Vaccination, *Science*, 297:937-9, 09AUG2002.

[9] *The Needs of Strangers*, Michael Ignatieff, 1984.

But we can hasten the process. What is required is the political will to install universal childhood immunization as an explicit societal need, plus implementation of an effective strategy. I believe the latter must include, among other aspects, the determination and discipline to continuously encourage and motivate and to otherwise manoeuvre national leaders into first accepting, then championing, this cause in their own political interest. Public recognition, the awarding of medals and other prizes for noteworthy efforts toward this goal would be appropriate catalysts in the right direction.

Our elected leaders have made the elimination of 'weapons of mass destruction' a global priority, and they are paying more attention to HIV. But public health leaders have to give and get that same visibility and global priority for universal childhood immunization. From a public health perspective, the war on 'terrorism' is attacking symptoms, attempting to address some of the consequences of social injustice. We must provide leadership to effectively address an important underlying root cause of social injustice: the massive under-use of today's vaccines, especially those with expired patents. We have to focus on the goal, not debate or have a stalemate interminably on entitlements versus market incentives and rewards.

Our children *are* our future. Their vaccination is necessary, is affordable, and is the right thing to do. We must explicitly commit to make it happen so that:

- we can see and we can promote universal childhood immunization, giving all children everywhere the best chance to live their lives;
- we can quantify each country's distance from it, thereby defining successes (which can serve as models) and failures (which become priority countries for assistance);
- we can assist the search for country-specific ways to attain success, one country at a time, relentlessly and without pause, until the laggards catch up; and, most importantly, we can shorten the time it would otherwise take to get there.

If we do these things, then we can confidently undertake the work that awaits us, a labour of love that will mark us among the worthy stewards of civilization itself.

Plenary 6

Human resources in epidemiology and capacity building

Chairpersons: *Ranjit Roy Chaudhury*
Palitha Abeykoon

Session Coordinator: *Yogesh Choudhri*

Human resource development for health research and capacity building: experience from Epidemiology Unit, Prince of Songkla University, Thailand – *Virasakdi Chongsuvivatwong*

Human Resources for epidemiology and capacity building: role of medical schools – *C S Pandav*

Epidemiological resources in the United States of America and their contributions to nation's health – *Scott Dowell*

Human resource development for health research and capacity building: experience from Epidemiology Unit, Prince of Songkla University, Thailand

Virasakdi Chongsuvivatwong

Epidemiological research is most essential for health-care planning and evaluation. It is the principle of quantitative logic and reasoning, leading to an unbiased estimate of the magnitude of problems, identification of risk factors and thus risk groups, and evaluation of the intervention programmes.

Unfortunately, there are only a limited number of well-trained epidemiologists in most of the developing countries. Instead of focusing on hard scientific evidences which are often too difficult to be appraised by less-trained people, epidemiologists are promoted to do administrative jobs, spending a large part of their time in the meeting rooms doing things based on intuition, which other people could also do.

The component of human resource and capacity for epidemiological research can be roughly broken down into three key components: planning, education, and management.

Planning involves conceptualization followed by commitment, which is expressed in the operation of the organization. In the planning stage, the dilemma related to the organization of epidemiologists is whether to put them in a few units so that their work could be consolidated, or to spread them around in various branches of the organization to support the institution more evenly. It is also important to declare their future responsibility. Without a clear statement of what mission epidemiologists-cum-researchers need to accomplish, further development of these experts will be directionless. Once the mission has been declared, and the organization has been sketched, selection of candidates must be done carefully. A good epidemiologist needs to have adequate basic understanding and experience of the subject matter, ability to learn and to think quantitatively, and, most importantly, to lead the team in the future.

Education or training of epidemiologists, based on competing demands and limited resources (like strong teaching institute and teacher), is also difficult to decide. Top administrative officers need to be trained on how to make use of existing evidence published in peer-reviewed journals in formulating policy. National experts in epidemiology must have enough time to conduct research, publish their papers in peer-reviewed journals, and communicate with top administrators as well as train other people. It takes time to build a real expert. Depending on the availability of human resources and scholarships, technical leaders in epidemiology could be trained at the Master's, doctoral and post-doctoral levels. A Master's graduate should be able to conduct simple surveys and run surveillance systems. A PhD graduate should be able to develop a careful research or working protocol, and a

post-doctoral trainee should be able to compete for the grant and independently publish in strong peer-reviewed journals.

Management of epidemiologists is the most important part of capacity strengthening. Job descriptions or terms of reference of epidemiologists must be clearly defined to avoid overwhelming them with ad hoc assignments and routine administrative work. The epidemiologist should be motivated by challenging missions that are well-supported administratively and financially. They should be working in a team, producing key information that can assist health planning. Research subjects should be well-focused and be relevant to local public health problems.

The Epidemiology Unit at the Prince of Songkla University was set up in 1989 with the aim to assist public health officers in conducting research linked to intervention programmes. The first five years of field research work and training of local people enabled the unit to understand the real health problems, especially diseases of poverty, and get acquainted with health personnel. The set-up was quite unique. Research, provision of technical consultation and research training were the main functions. It is not responsible for the teaching of medical students. The unit was granted financial autonomy but without routine support from the government or the university budget. The income in the first few years was purely from research grants.

Epidemiology is a very important tool in study design, planning of data analysis, interpretation of results and communication with others. In parallel with research in southern Thailand, the Chief of the Unit was invited to join WHO taskforce on safety and efficacy of fertility regulation methods, formulating priority and review research proposals and reports.

A research unit without graduate students does not serve any significant purpose. Short-term training for health officers is not adequate for long-term human resource development. Thailand needed a strong graduate programme in epidemiology. From WHO's perspective, sending fellows from Asia to study in a centre which enjoys a good reputation, is more cost-effective and is culturally more adaptable than centres in Western countries, is a preferred choice. In its sixth year of functioning, after careful assessment, an International Programme for Graduate Study in Epidemiology was set up, with students from Thailand's neighbouring countries, under WHO support. This course is very much research-oriented, with heavy credits on quantitative science of epidemiology and statistics and a practicum of short-term field work.

The first year prepares the student for the thesis. In the second year, teachers assist the students in planning high-quality research protocols which were executed in the students' home countries for their theses. This ensures that the students can certainly conduct research back home in their country. Along with the graduate programme, the unit was requested to provide consultation visits to various institutes where the students come from. Experience from these consultations then further strengthened the capacity to teach future students and vice versa.

Four years later, the academic demand increased to doctoral education to ensure high-quality researchers. International publication became the benchmark of academic quality. A research topic serving only a local public health need is insufficient to get the research results accepted for publication, it must be of international interest and quality. In the late 1990s, the Internet spread far and wide. International collaboration has also become more positive. Students get ideas from the PubMed database. They can also learn from experts around the world through browsing their lecture notes and slides posted on the Internet and discussing directly with top researchers in Western countries via e-mail about their proposal and manuscripts. The number of our students gradually increased over time; Figures 1 and 2 summarize the number of Master's and PhD students from various countries since 1992.

There are certain differences between our graduate programme and those in the West. Our class is smaller, making for closer contact among students and staff. Very often a professor in the West has

Fig. 1: Number of Master's degree students by year of enrolment

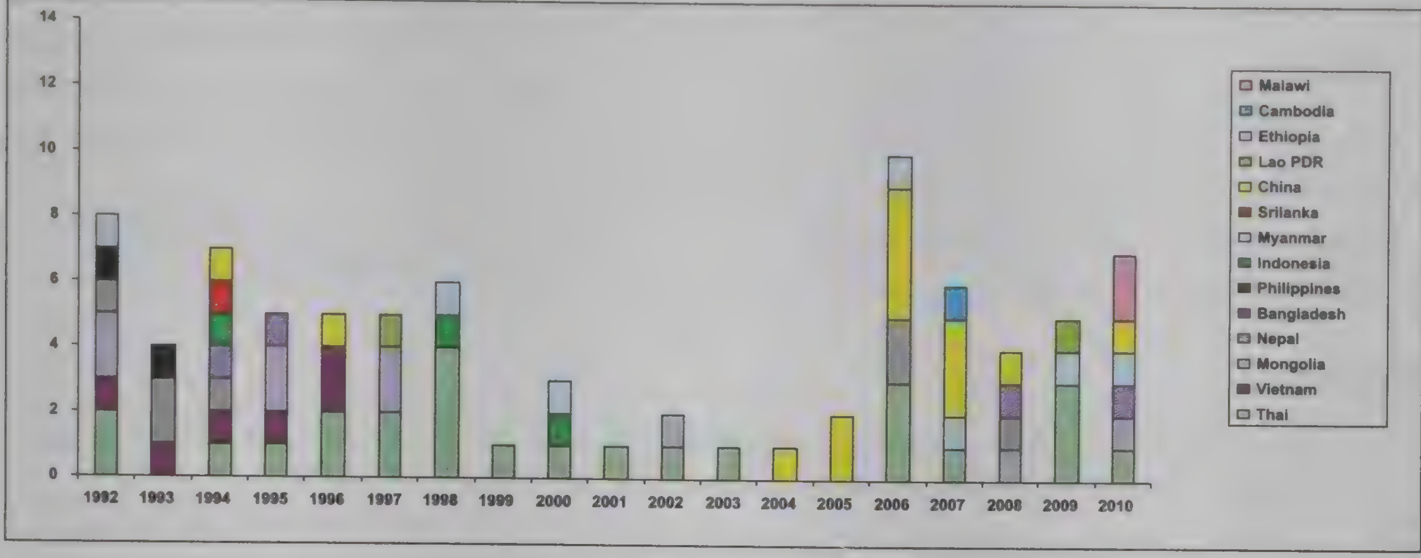
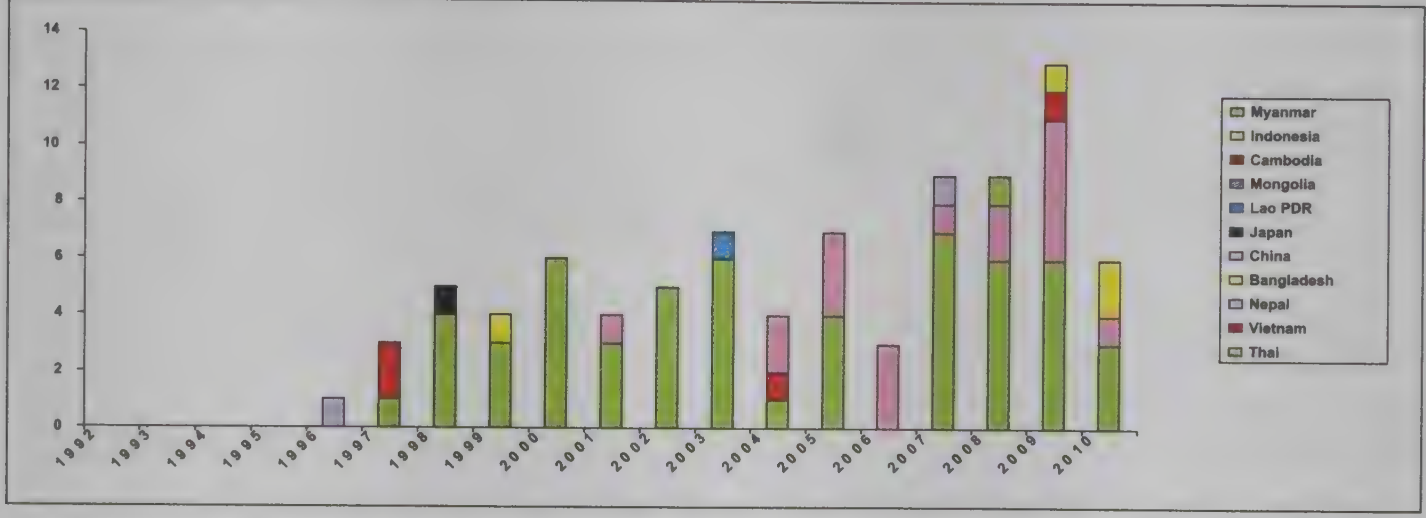


Fig. 2: Number of PhD students by year of enrolment



a big research grant, needing graduate students to work for him/her. In contrast, the research topics among our students are mostly student-centred. Students in a large university in the West shop around to take credits or sit in at various courses. Our university is relatively small. When the core course is finished, our students are encouraged to find further knowledge necessary to conduct research by themselves under the general advice of our teaching staff. A number of students also need to write research proposals to get funds from external agencies, thus learning from grant reviewers who are not their teachers. By this style of training, knowledge may be gained slower but the method of self-learning is firmer.

The other kind of international education system that we have been running is an Internet-based open-course. We teach epidemiological data analysis to the participants worldwide via the Internet at http://medipe.psu.ac.th/elearning using open-sourced software R and our package Epicalc and our open-book "Epidemiological Data Analysis using R and Epicalc", which can be downloaded from http://www.cran.r-project.org. Since 2006, there have been more than 1500 participants registered in this course. There is no prerequisite or any endorsement from the institute. The participants can log in at any time during the course. They download the lecture notes, join the discussion forum on the Internet, download and submit assignments, which would be marked and discussed individually and in the class. This is perhaps one of the cheapest methods of worldwide education. The course was attended by participants from various countries in different continents that included mostly Asia,

Africa and Latin America. Participants from other countries such as the USA, France, Spain, the UK, Singapore and Taiwan, China, also joined. The only obligation for this kind of education is that the participants must be highly motivated and have enough spare time, at least 15-20 hours per week. Otherwise, they tend to drop out. There is no credit. Thus, it does not lead to any degree. An electronic certificate of attendance and a hard copy of the open-book are given to those who regularly and successfully submit all the assignments on time during this 9-week course.

With various kinds of education facilities provided by us, we hope we can contribute more to human resource development for epidemiological research in countries all around the world.

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Human resources for epidemiology and capacity building: role of medical schools

Kapil Yadav, Baridalyne Nongkynrih, Anand Krishnan and Chandrakant S. Pandav

Translating public health policies and programmes into improved health of population requires a trained workforce capable of implementing them. Globally, as we near the deadline of 2015 to achieve the Millennium Development Goals (MDGs), there is a greater realization that if current trends continue it will be difficult to achieve the set targets *(1)*. Policy-makers globally have realized that in the absence of adequate quality human resources it will not be possible to transform public health goals into reality at ground level. Epidemiology, by providing a conceptual and basic understanding of formulating and implementing public health interventions, in addition to being the cornerstone methodology of public health, has now been widely accepted as a vital transdisciplinary approach essential to attain health for all.

Epidemiology is defined as the "Study of distribution and determinants of health- related states or events in specified populations, and the application of this study to the control of health problems" *(2)*. The essence of epidemiology can be best summarized in the words of Rudyard Kipling, "*I keep six honest serving-men (They taught me all I knew); Their names are **What** and **Why** and **When** and **How** and **Where** and **Who**" (3)*. Epidemiology fulfils the broader mandate of public health as "Epidemiology is fundamentally engaged in the broader quest for social justice and equality" *(4)*. Epidemiology has all the attributes to act and should act as a bridge between public health, medical science, social sciences as well as liberal arts.

Epidemiology capacity building

The following questions need to be addressed for capacity building in the light of its current status.

(1) Who are the stakeholders?

Epidemiology is a way of thinking, an analytical paradigm that is essential for all, even in day-to-day living. But, let us begin with health. All human health resources, from field-level workers to policy-makers, require an understanding of the distribution of health and its determinants in terms of place, person and time. The need and level of epidemiology skills required will vary at different levels. Field-level health workers need epidemiology to understand the need for denominators and usefulness of the data they generate. Policy-makers need epidemiology to understand the concepts of burden of disease, effectiveness and efficiency to make appropriate policies.

(2) What is the current status of different stakeholders regarding epidemiological training?

Currently, epidemiology training is suboptimal among all stakeholders. Grass-root worker are not sensitized to epidemiology at all. Other health professionals like nurses, laboratory technicians,

rehabilitation personnel etc. are currently not exposed to any training in epidemiology whatsoever. As per Medical Council of India curriculum, sufficient emphasis is given on epidemiology training in medical education. However, epidemiology is taught as a theoretical subject through didactic lectures. Medical students are unable to appreciate practical application of epidemiology in their medical practice. Our recent experience with two districts in the preparation of District Plan for National Rural Health Mission showed serious gap in epidemiology training of program managers. There was total absence of denominators in planning at district level and inadequate capacity to understand data. Quality of training of public health specialists is quite variable. Despite opening of many schools of public health in the country, the quality of training of public health remains a major cause of concern. Policy makers currently have no avenues for sensitization to the principles of epidemiology.

(3) Why is it so?

Historically public health and epidemiology are not given due importance due to a lack of understanding of its importance and wider application to deliver health care to all. Important public health offices continued to be occupied by people not trained in public health and epidemiology. Inertia and rigidity in the system resisted any change even after the realization that public health and epidemiology skills are essential to achieve health for all and that it is also a specialized discipline like cardiology or cardio-thoracic surgery. Due to lack of well defined career path for public health specialist, those practicing public health suffer from lack of motivation. Due to lack of priority accorded to epidemiology there is lack of teachers in public health.Even the few teachers who are there have inadequate capacity in terms of skills, training and potential to motivate students.

(4) What capacity needs to be strengthened?

The existing infrastructure needs to be upgraded to create adequate facilities for epidemiology training. Human resources, both in terms of quality and quantity of both teachers and support staff, also need to be augmented. Major revised inputs in terms of increased allocation of funds are required to aid the upgradation of both infrastructure and human resources. There is also a need to standardize the course curriculum as well as methods of assessment so that a uniform pattern can be established. These should be accredited and monitored for both quality and content. In order to promote greater interest in and realization of the importance of public health and epidemiology, due weight should be given to the marks obtained in these subjects.

(5) How can it be done?

Our experience of training health workers and undergraduate and postgraduate students at All India Institute of Medical Sciences (AIIMS), New Delhi, illustrates that, with appropriate inputs it is possible to improve the teaching of epidemiology in medical schools. The two methods to achieve this are: make epidemiology training/teaching problem-based, and, link it to the routine activities of the trainees/students. Both these changes enabled us to make epidemiology training more interactive and at the same time made the trainees/students appreciate the practical use of the principles of epidemiology in their routine day-to-day activities.

(6) When should it be done?

We have already lost valuable time in recognizing the need for and importance of epidemiology. Efforts to revitalize and reinvigorate epidemiology capacity building should start immediately without losing any further time.

(7) Who should do it?

All institutions including medical colleges, universities, schools of public health, state institutes of health and family welfare and nongovernmental organizations (NGOs) need to come together to strengthen the epidemiology capacity building efforts.

(8) How do we know that we are doing it?

Along with initiating efforts to strengthen epidemiology capacity building, it is vital that whatever is being done is also monitored. We need to develop clearly-defined and measurable outcomes to monitor and assess progress towards predefined goals and recognize the need for mid-course correction if needed.

Experience from All India Institute of Medical Sciences, New Delhi

The Medical Council of India (MCI) has recommended that, "The broad goal of the teaching of undergraduate students in community medicine is to prepare them to function as community and first-level physicians in accordance with the institutional goals." In order to achieve these goals, it has laid down certain objectives which include knowledge of important public health problems, to be familiar with the health system, and learn certain basic epidemiological skills *(5)*. AIIMS, in accordance with the guidelines laid down by the MCI, has an extensive programme for the training of undergraduate MBBS students in community medicine. The undergraduate programme in community medicine starts from the third year of medical training where the students are exposed to a sequential method of teaching in community medicine and is carried on through internship. The details of the MBBS teaching programme in AIIMS have been described elsewhere *(6,7)*. Epidemiology is one of the major components covering about 30% of the syllabus. The division of areas and mode of teaching is given in Table 1.

Table 1: Areas covered and mode of teaching of epidemiology at AIIMS, New Delhi, India

Semester	Mode of teaching	Areas covered
3rd & 4th semester	Theory (16 lectures)	Theoretical aspects • Basic epidemiology • Biostatistics
Urban posting 4th & 5th semester	Practical (50 days)	Research methodology • Planning a study • Designing a tool • Data collection • Basic statistical analysis
Rural posting 7th semester	Practical (5 weeks residential)	Applied aspects • Basic concepts (revision) • Higher statistical skills • Critical review of papers

Theory classes are meant to introduce the basic concepts of epidemiology. These start from the 3rd semester, i.e. the second year of medical training. Practical sessions in urban areas are held for small batches of 10-12 students where they are introduced to the principles of carrying out community-based research, data collection and analysis under the guidance of the faculty. In the 7th semester, i.e. fourth year, the students are exposed to a higher level of epidemiology, critical review of literature and applied epidemiology (Table 2). Some examples of the exercises undertaken to reinforce epidemiological

concepts are given in Box 1 and Box 2. Some of the students' epidemiological exercises have also qualified for publication and this serves as a good motivation for learning *(8-12)*.

Table 2: Sessions and mode of teaching of epidemiology in the 7th semester in rural posting at AIIMS, New Delhi, India

No.	Time (minutes)	Topic	Exercises
1	90	Choosing study design - research hypothesis	Group discussion
2	90	Sample-size consideration	Group discussion
3	90	Sampling, bias, randomization and blinding, causation	Group discussion
4	90	Validity, reliability and agreement p-value, 95% confidence intervals	Group discussion
5	180	Data analysis on ready dataset	Supervised session
6	120	Interpretation and presentation	Group discussion
7	120	Critical review - guidelines	Group discussion
8	120	Critical review – workouts with sample papers	Group discussion
9	120	Revision/buffer session	

Critical analysis

The epidemiology teaching at AIIMS has evolved over many decades. Its strengths are that the curriculum has well-defined objectives, methodology, expected outcome, monitoring and supportive supervision, and there is an objective method of assessment. It is constantly being reviewed and updated according to the needs of the students and changing disease scenario. The opportunity for hands-on training and practical teaching generate interest in the students as compared to theoretical didactic lectures.

The field practice areas for community medicine, both in urban and rural areas, provide a community laboratory for teaching and research. The added advantage of the rural field practice area is that it is a stable population; therefore, a good ground for longitudinal studies and also a platform for training of students from within and outside the country. Besides, the availability and accessibility of faculty members as well as other resources like library and the Internet facilities, transportation, accommodation, recreational and basic amenities (water and electricity) and other support staff makes residential rural posting feasible and enjoyable.

There are examples of innovative teaching in epidemiology which have been tried in some medical colleges in the country. The Department of Community Medicine, Mahatma Gandhi Institute of Medical Sciences, Wardha, Maharashtra, has a well- established training programme in community medicine. The institute adopts one village for each batch of medical students. All the families in the village are distributed among the medical students and thus each student gets the responsibility for 3-4 families. These families become the adopted families of a particular student. Initially, a social service camp of 15 days is organized where all students visit their adopted families daily. After the camp, for the *next four years*, the students visit their adopted village every month on a Saturday. The institute conducts a two-day workshop on 'Problem-Solving for Better Health'. During the workshops, the

students are taught how to identify and prioritize problems, how to develop options for solving a problem, how to implement the intervention, and how to present the findings *(9)*.

Another example of a community-based practical teaching of epidemiology is the one carried out by the Department of Community Medicine in the Christian Medical College, Vellore, Tamil Nadu. In order to facilitate this, the community health and development programme was established in 1974 for providing health and developmental inputs to a population of 100 000. In the first year, there is a community orientation programme where students get a live-in experience in a village for two weeks. They learn to collect quantitative data and analyse it using simple statistical methods. In the second year, they visit the same village and gather information on vital events and carry out a morbidity survey. The data so gathered is used to learn basic epidemiology and statistics. During this block posting, the emphasis is on epidemiology, health planning, health care delivery system and national health programmes. In the third year, students are divided into batches of six each and each batch takes up a research question related to any of the areas of public health importance. They prepare the instruments for study and gather field- based data and present their findings to the entire class. The whole exercise is problem-solving in nature and they also learn to share the information so gathered with the community *(10)*.

However, the purpose of training medical students in epidemiology as well as in other subjects seems to have been lost over the years. The lucrative opportunities in Western countries draw most of the students to greener pastures. This is against the goal of medical education in India. It was envisaged that the students would be provided high-quality education so that they will, in turn, serve the nation.

The way forward

There is an urgent need to standardize course curriculum in epidemiology for all levels of stakeholders to ensure quality teaching across the spectrum. Along with standardizing the curriculum, there is a need to prepare teaching resources for these courses which are interactive and practical. The epidemiology teaching/training should be problem-based and linked to routine activity of the trainees, reinforcing the daily utility of epidemiology. There is a need to create a critical mass of teachers of epidemiology in all countries in the WHO South-East Asia Region - both in terms of number and quality. These teachers should act as role models for students and motivate them to learn the essential skills of epidemiology.

The epidemiology capacity building can be strengthened by creating a demand for public health in general, and epidemiology in particular, within the national health system. The demand for skilled epidemiology workforce, coupled with adequate remuneration, will inspire students to adopt epidemiology as a career. This, in turn, will strengthen the availability of human resource, both at country and regional levels.

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Epidemiological resources in the United States of America and their contributions to nation's health

Scott F. Dowell

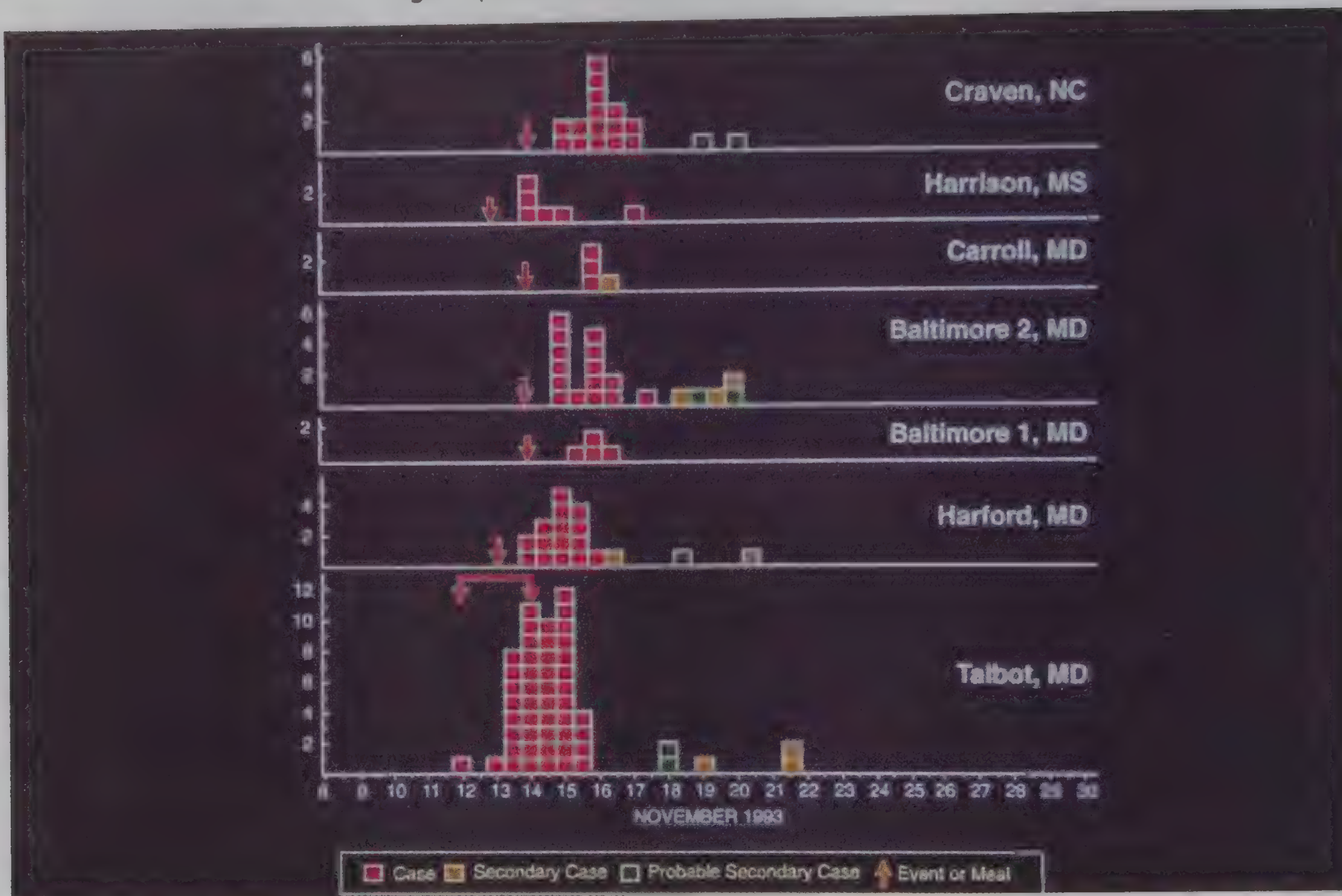
The Epidemic Intelligence Service (EIS) is responsible for building epidemiology capacity not only in the United States of America but also in the global disease detection programmes. EIS is a 2-year programme for those who have graduated. It is really an on-the-job training programme for people interested in applied epidemiology. The Centers for Disease Control and Prevention (CDC) was established in 1946. Its predecessor was an institution called malaria control in rural areas. In 1947, the institution was given the responsibility of providing epidemic aid to the states. By 1951, EIS was established by Alexander Langmuir, who has been called the father of epidemiology in the USA. He was the one who coined the term 'shoe leather epidemiology' to describe what he was teaching. It meant that those who did epidemiology would have small holes in the soles of the shoes by walking around so much. The symbol of EIS is still a shoe with a small hole in the bottom.

EIS has not changed much since the beginning. It includes applied epidemiology and emergency response. It has usual structured courses, case-studies, exercises, etc. It also requires on-the-job training, mentoring with experienced epidemiologists and experience of learning in the field. To be eligible to join EIS, generally, one should have an advanced degree. The largest categories of physicians trained in EIS have at least a year of postgraduate training. In recent years, other health professionals have joined, which include veterinarians, nurses, dentists and others. Those with a doctoral degree in related fields like epidemiology and biostatistics are also able to join.

I joined the EIS programme after completing paediatric residency. I was very excited to be accepted to the EIS programme. I had heard about it from one of my mentors, a man named Neal Halsey, at Johns Hopkins, and also learnt more about it by reading a book by Burton Roche, titled The Medical Detectives, which is a compilation of short stories about epidemiological investigations that made the experience seem very glamorous and exciting. The first epidemic curves that I ever made after the first outbreak I investigated is shown as Fig.1. Many of these outbreaks occurred in Maryland, which is where I was posted. Most of the affected people ate oysters. My colleague was assigned to the state of Louisiana for sampling the water. In fact, he made interesting calculations about what would happen if an oysterman vomited over the edge of the boat. It is impressive how much water oysters can filter, extracting the viruses from the water and preserving them for people who eat them. My job was to trace the oysters back to the origin.

The outbreaks were traced back through the retailers, wholesalers, distributors, factories, and to the ships that harvested the oysters in different parts of the coast of Louisiana. It was not clear that this was the source point of the outbreak. One of the colleagues came up with a new technology of amplification of the genome sequence of the virus. These viruses were then called 'small round structured viruses'. They are now called noroviruses. Dr Tami Ando, a visiting scientist from Japan, working in the laboratory of Roger Glass at CDC, had brought this new technology. We were able to show that in fact all of the isolates from different outbreaks were very similar. In fact, it was a point

Fig. 1: Epidemic curves of outbreaks of diarrhoea

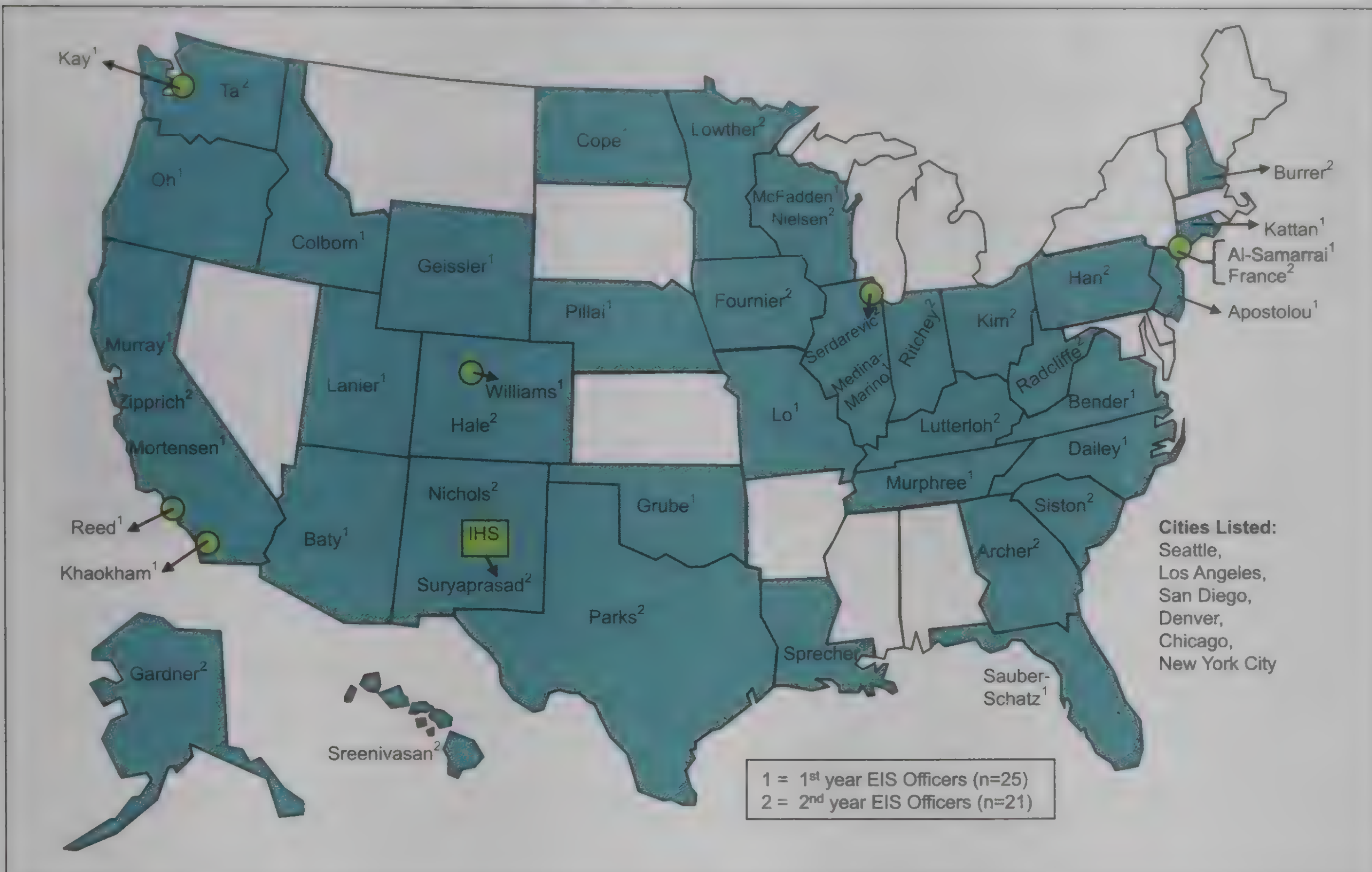


source outbreak. This is the importance of international collaboration and the ability to learn from scientists who are doing innovative work in other parts of the world. As part of the requirement for completing EIS, a publication in a peer-reviewed journal was an essential requirement, which tends to keep the quality of the investigations up to a level that can withstand the scrutiny of peer review.

Some EIS officers are assigned to headquarters, as I was in Atlanta, but many of them are assigned across the country. In fact, there are few states that do not have an EIS officer. The country is essentially blanketed not just by EIS officers but by EIS graduates who make up state epidemiologists and others working in states across the country (Fig. 2). Over time, about 70% of EIS graduates remain in public health, 20% in academia and a little bit less in private practice. The percentage working in public health has gone up. In fact, about 20 to 30 years ago, a little bit more worked in academics but as the capability of epidemiology in the public sector has grown, its demand has also grown, and opportunities for graduates have gone up. It also means that the leadership of epidemiology in the US is heavily weighted by graduates of the EIS programme.

Why has EIS worked? First, it recruits talented professionals through a competitive process. It is only about 1 in every 3 or 1 in every 5 who apply are accepted. Second, it is competitive in part because it pays well. I remember leaving paediatric residency and joining EIS as there was a pay increase in that transition. Third, mentors are leaders in their field so trainees have the opportunity to work for two years with people who are on the cutting edge of public health science, and trainees learn from them during investigations so that the training takes place not in the classrooms so much as in the field. Finally, it provides a strong career path; EIS does not confer a degree but it confers a certain prestige in the epidemiology communities in the USA. People recognize what it means to have been through the EIS programme.

Fig. 2: Field EIS Officers, USA, 2009-2010



Global Disease Detection (GDD) is CDC's main programme for developing and strengthening the capacity to identify and contain diseases throughout the world. Accomplishments of the programme are measured in five areas: outbreak, response, surveillance, pathogen discovery, and training. Training is one of the most important areas. Recently, a WHO collaborating centre was established for national surveillance and response capacity building for international health regulations. The terms of reference of the collaborating centre explicitly are to conduct training in field epidemiology and laboratory methods. This centre will focus even more on capacity building and training in field epidemiology. In collaboration with CDC's Centers of Health, since 2006, over 500 outbreaks have been investigated. Up to 70% of the outbreaks were responded to in less than 24 hours from the time that the request for assistance came in from the host country. The proportion that has laboratory testing as part of the investigation was 75%. Of those, 69% have identified pathogens. The public health impact in this past year was 91%, which led to either formal publication of a report, a policy change, or ideally lives saved (Fig. 3). Up to 49 new pathogens have been detected, three of these are brand new to the world and the rest are new to the region; 152 pathogen-specific tests have now been brought to the host countries as a result of the technology transfer that is an important part of the programme.

Another model for epidemiology training has been worked by the field epidemiology training programme (FETP) in Central America, especially in Guatemala. It includes the field epidemiology training programme, a 2-year intensive training for professionals at the top of the pyramid, but just below these are shorter courses for intermediate epidemiologists, and at the base a very brief course for epidemiology at the most peripheral levels (Fig. 4). This approach provides both trainee and professionals the career path. Those completing the basic epidemiology training can move on and take the intermediate and then the top-level courses, but in addition the mentorship cascade provides the opportunity for those at the upper levels to train those at the levels below. As a result, the graduates

Fig. 3: IMPACT of Global Disease Detection (GDD) Program

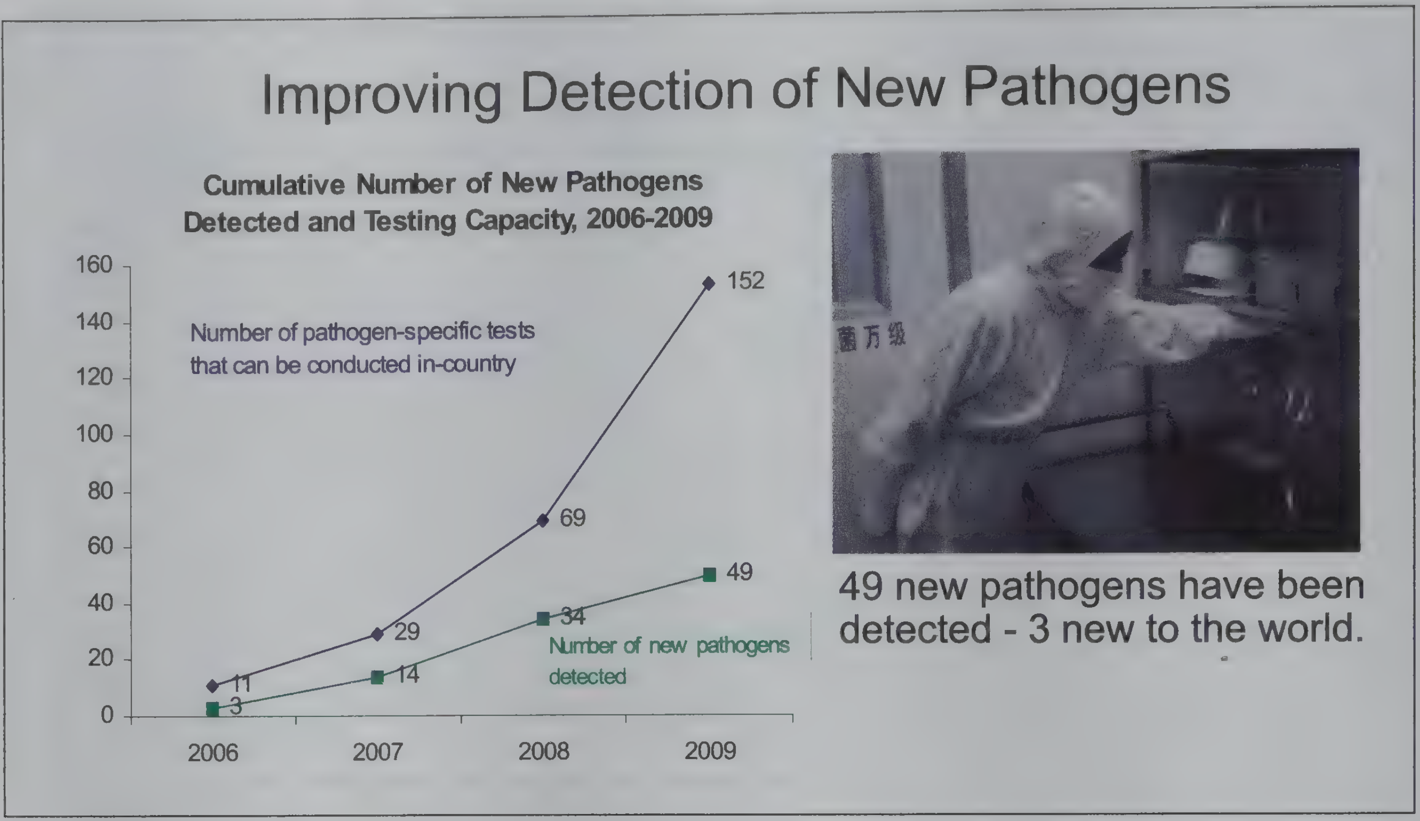
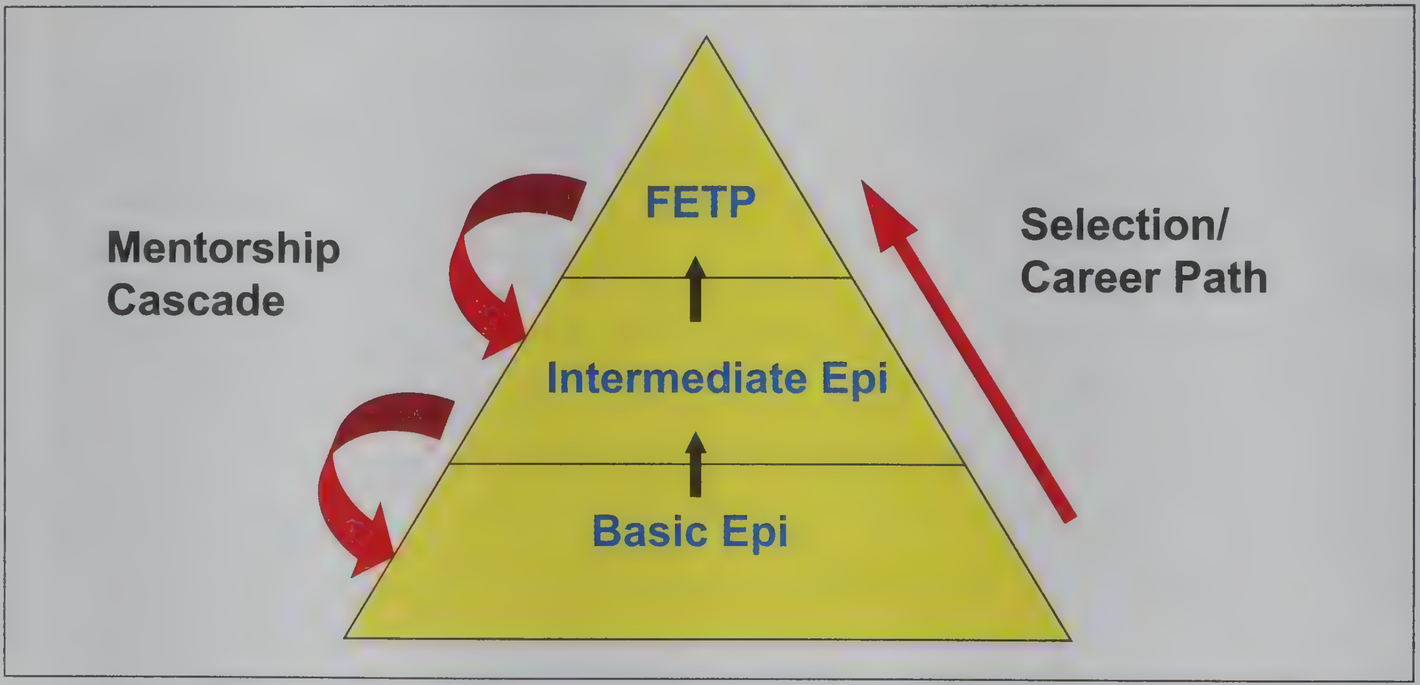


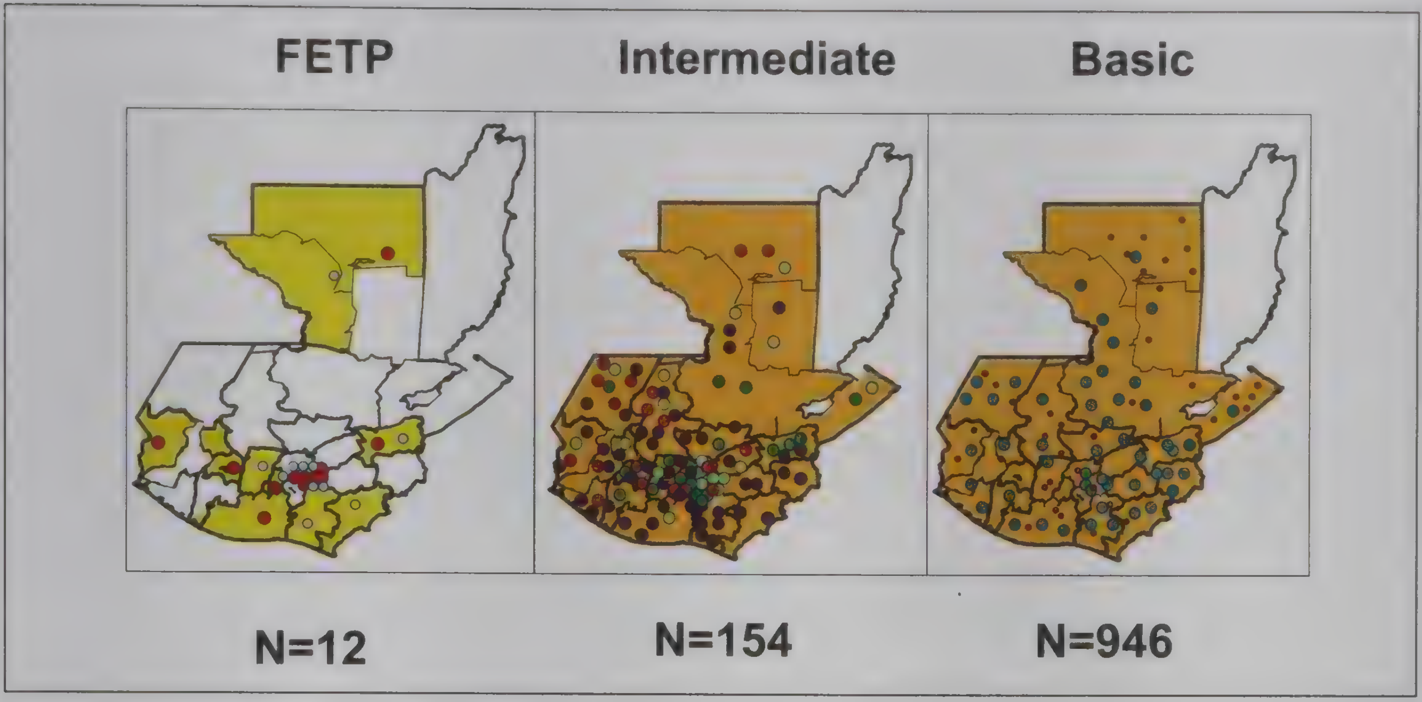
Fig. 4: FETP/GDD training in Guatemala – Pyramid Concept



of the FETP are beginning to be employed in the public health system in Guatemala. Those from the intermediate and basic levels have already been placed across the country (Fig. 5). That is a very quick way of building basic epidemiology. Primarily, those who graduate at the top level, up to over 200 graduates of the FETP, were trained at the Global Disease Detection Center of the CDC.

CDC has the following five new global health strategic approaches: (1) to assist ministries of health to be successful; (2) to achieve goals of disease eradication and elimination; (3) to expand global health programmes, especially in the areas where there is the biggest opportunity to make an impact on death

Fig. 5: Distribution of Graduates and Trainees
Guatemala, 2001-2010



and disability including noncommunicable diseases; (4) to do research and apply that knowledge; and (5) to strengthen health systems. But to improve global public health, field epidemiology training may be the single most important thing that CDC can do, and which is going to be an increasing focus for CDC in the coming years.

It is quite apparent that field epidemiology training is an essential part of building epidemiology capacity. Some countries that have resources of their own may consider the EIS model. A parallel approach that was used in Central America is another way to accelerate the process of building basic and intermediate levels of epidemiology across the state and local levels. The GDD programme of CDC, as one of the resources, can contribute to epidemiology capacity building.

Section 3

Special lectures

Special Lectures

Economic crisis and health of the poor: evidence matters – *Jacques Jeugmans*

Introduced by: *Tee Ah Sian*

The use of epidemiological data to monitor and evaluate programme performance

– *James Chin*

Introduced by: *Lalit M Nath*

Economic crisis and health of the poor: evidence matters

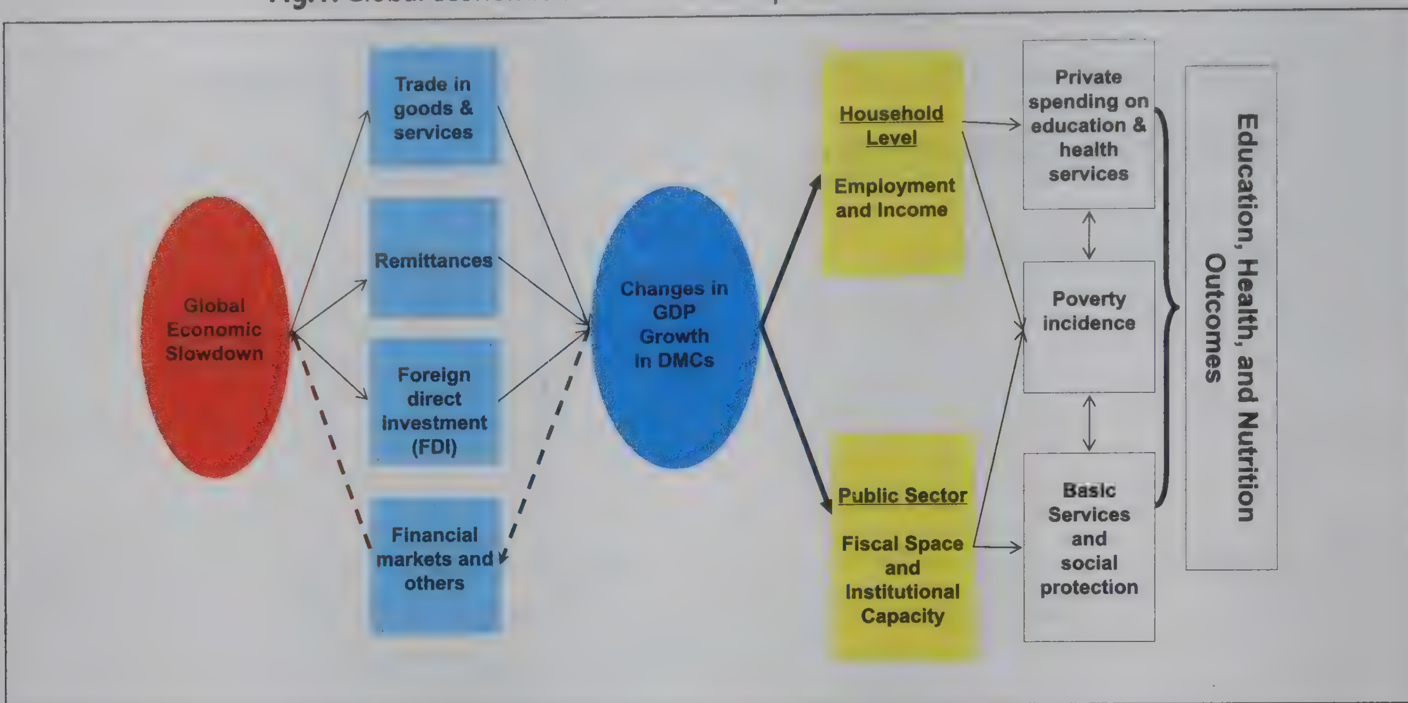
Jacques Jeugmans

Global economic slowdowns are likely to have adverse impacts on the education, nutrition and health of the people. Governments, international organizations and donor agencies react to economic crises by adapting policies and reallocating resources to mitigate these adverse impacts. But in a crisis, there are many competing demands. Therefore, it is important that public health specialists must develop strong advocacy skills to protect the interest of public health, particularly for the poor and other vulnerable groups. Advocacy is much more effective when supported by evidence, data and sound analyses. It is important for public health specialists to understand and use arguments that decision-makers understand. This paper, based on the work of Asian Development Bank (ADB) colleagues and others, will first describe how economic analyses and data can help develop better policies to protect health, especially for the poor. Then, the preliminary results of a rapid survey led by Professor Soonman Kwon, who tried to collect real-time data and information on the impact of the ongoing crisis on the health of the poor in the Asia and the Pacific Region, will be presented. And, finally, I will conclude with some recommendations.

Global economic crisis: channels of transmission

How does a global economic crisis eventually affect the health, education and nutrition of the people locally (Fig.1) *(1)?* In a globalized economy, particularly in Asia and the Pacific, trade in goods and services, foreign direct investments (FDIs) and remittances are driving the economic growth. In a global slowdown, trade, remittances and FDIs decrease, which then reduce the economic growth of many countries. In the present crisis, financial markets have also been disturbed, which has further affected most economies. At the local level, unemployment increases and incomes decrease, both at the household and public sector levels. Because of unemployment and reduced incomes, household poverty increases and thus private spending on health and education diminishes. While poverty increases, lower tax collection and bankruptcies reduce governments' revenues. With less revenue, governments have less fiscal space and face difficulty in maintaining social protection programmes, sometimes even forced to consider reductions in public spending for education and health. While demand for social services increases because of increasing poverty, supply (by governments) is difficult to maintain because reduced government incomes limit governments' spending. Reduced social spending by both households and governments has adverse impacts on health and education.

Fig.1: Global economic crisis and local impacts channels of transmission



Source: G. Wan, ADB Sustainable Development Working Paper

Country vulnerability

All countries are not equally hit by global economic crisis (Fig. 2). To assess the impact of a global economic crisis, it is useful to determine a country's vulnerability. A country's vulnerability to external setbacks depends on the structure of its economy ('exposure' on the left side of Fig. 2) and on its internal capacity to cope ('capacity') on the right side of Fig. 2). Every country is differently affected. Exposure is determined by the structure of the economy and the drivers of economic growth: trade, foreign investments, remittances, overseas development assistance and tourism. The impact of a global crisis on a country which does not rely significantly on exports will be less than the country which relies heavily on export. The same is true for the remittances; for example, if remittances are coming from the Middle East, which this time does not seem too much affected by the global crisis, the country will be less affected than a country getting remittances from the USA or Europe. The

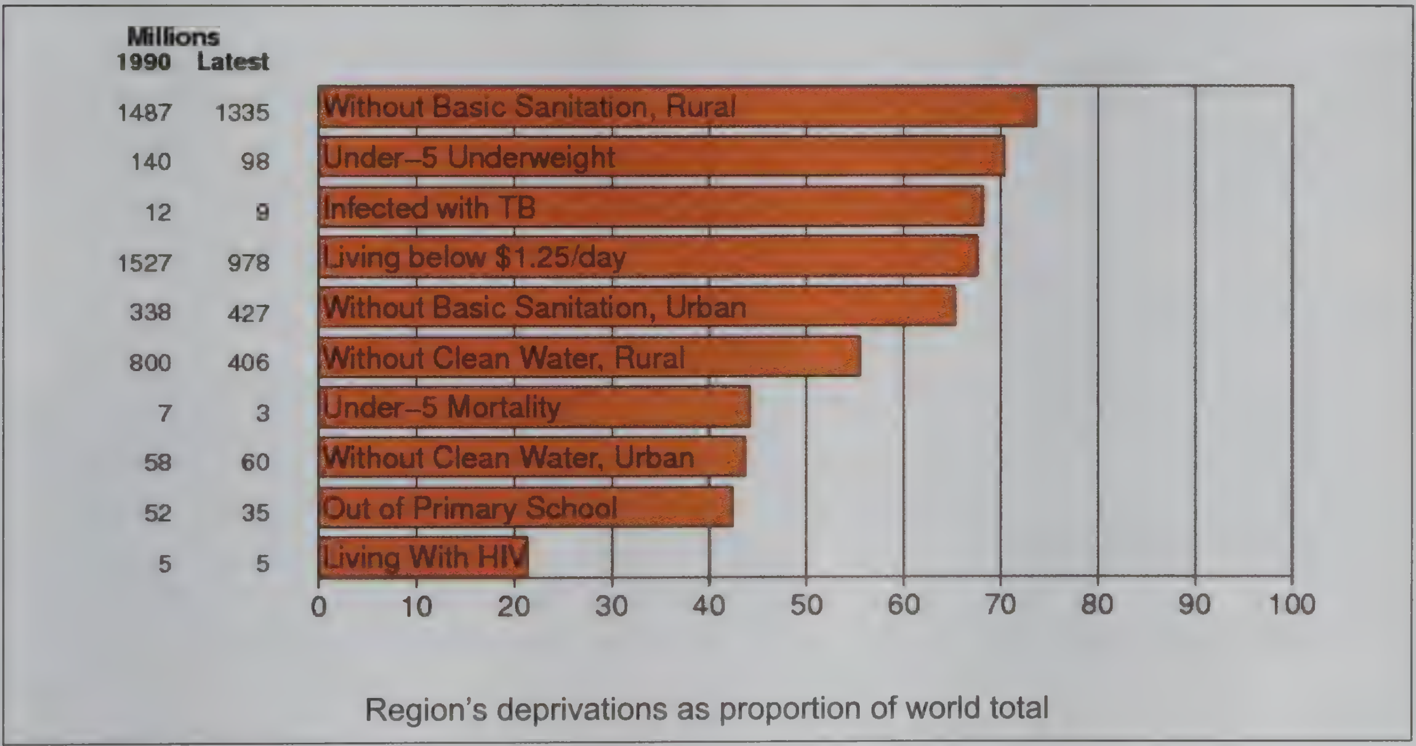
Fig.2: Impact of a global economic crisis

impact will be greater on those countries that are sending workers overseas to the countries that have been severely affected by the crisis and therefore have cut employment. The other determinant of a country's vulnerability is its capacity to react. Coping capacity is linked to macroeconomic stability, institutional development and level of social development. In countries in south-east Asia, for example, coping capacity is relatively good and exposure is relatively limited, compared to Pacific islands countries where exposure is very high and coping capacity is low. The Asian Development Bank, the UN Economic and Social Commission for Asia and the Pacific (ESCAP) and the United Nations Development Programme (UNDP) have developed an index of vulnerability of countries taking into consideration both their exposure to the crisis and their capacity to react to it.

Progress towards achieving the health Millennium Development Goals (MDGs)

Before the economic crisis hit the region, countries had made unequal progress towards achieving the MDGs. The ADB-UNDP-ESCAP 2009-2010 MDG report *(2)* indicates that the Asia Pacific region (except for Central Asia) is on track to achieve the MDG goal of poverty reduction (with south-east Asia having achieved its objective but south Asia being a bit slow). For the health-related MDGs, south-east Asia and north and central Asia are on track. But others are much too slow to reach the targets. For under-five child mortality, south-east Asia is on track but all other countries are too slow. The same is observed for births attended by skilled professionals; Pacific island countries are even regressing. For basic sanitation, targets may not be achieved. In general, 70% of the people in Asia and the Pacific remain without basic sanitation (Fig. 3). If MDGs are to be achieved by 2015, governments and development partners need to pay greater attention to social policies.

Fig.3: Magnitude of Deprivations



Source: ADB, UNESCAP and UNDP

Assessing the probable impact of the crisis on poverty and social sectors

Basically, economists can use two methods for assessing the impact of the economic crisis on the poor: ex-post and ex-ante assessment. In an ex-post assessment, the researcher reviews and analyses recent economic crisis to find out what has been the impact of the crisis. An ex-ante assessment tries

to predict the impact of the crisis on the basis of the most recent available information, recognizing that data are still incomplete or even incorrect at this time.

Ex-post assessment

The region was severely hit by the 1997-1998 economic crisis. Based on the channels of transmission just described, data on economic growth, households' expenditures, public health expenditures and poverty in general, during and after the 1997 crisis, may help estimate the poverty and health impacts of the present crisis.

Data for selected countries in the region (Indonesia, Malaysia, Korea, Thailand, Philippines) indicate clearly that while the gross domestic product (GDP) was growing steadily at 5%-8% annually (a bit less for the Philippines), there was a significant decrease in the GDP growth in 1998 (negative GDP growth) in all countries, but a relatively rapid return to the average annual GDP growth after 2001. The same profile is observed for household expenditures. Variations can be explained by the structure of the economy of each country. In the Philippines, for example, in the 1997-1998 crisis, remittances from other parts of the world less affected by the crisis may have protected household expenditures partly. There is more variety for public health spending, reflecting the governments' different responses to the crisis. In response to the 1997-1998 crisis, Thailand chose to strengthen its safety net programmes, and per capita public health expenditures increased from 1998 to 2001, which was not the case in Indonesia and the Philippines. In Indonesia, public health expenditures increased in 1999, decreased in 2000 (when the country was preparing decentralization), and increased again in 2001.

The economic crisis of 1997-1998 had a significant impact on poverty. In Indonesia, 11% of the population was considered living below the poverty line before the crisis; the figure increased to almost 20% in 1998. In the Philippines, the number of people living below the poverty line increased by 9%. In most countries, inequality increased. In Indonesia, the expenditure share of the bottom 40% declined from 17.2% in 1996 to 16.8% in 1998. It may not seem a very big difference but the amount it represents is significant. In the Philippines, the income share of the bottom 40% declined from 12% to 10% in 1998.

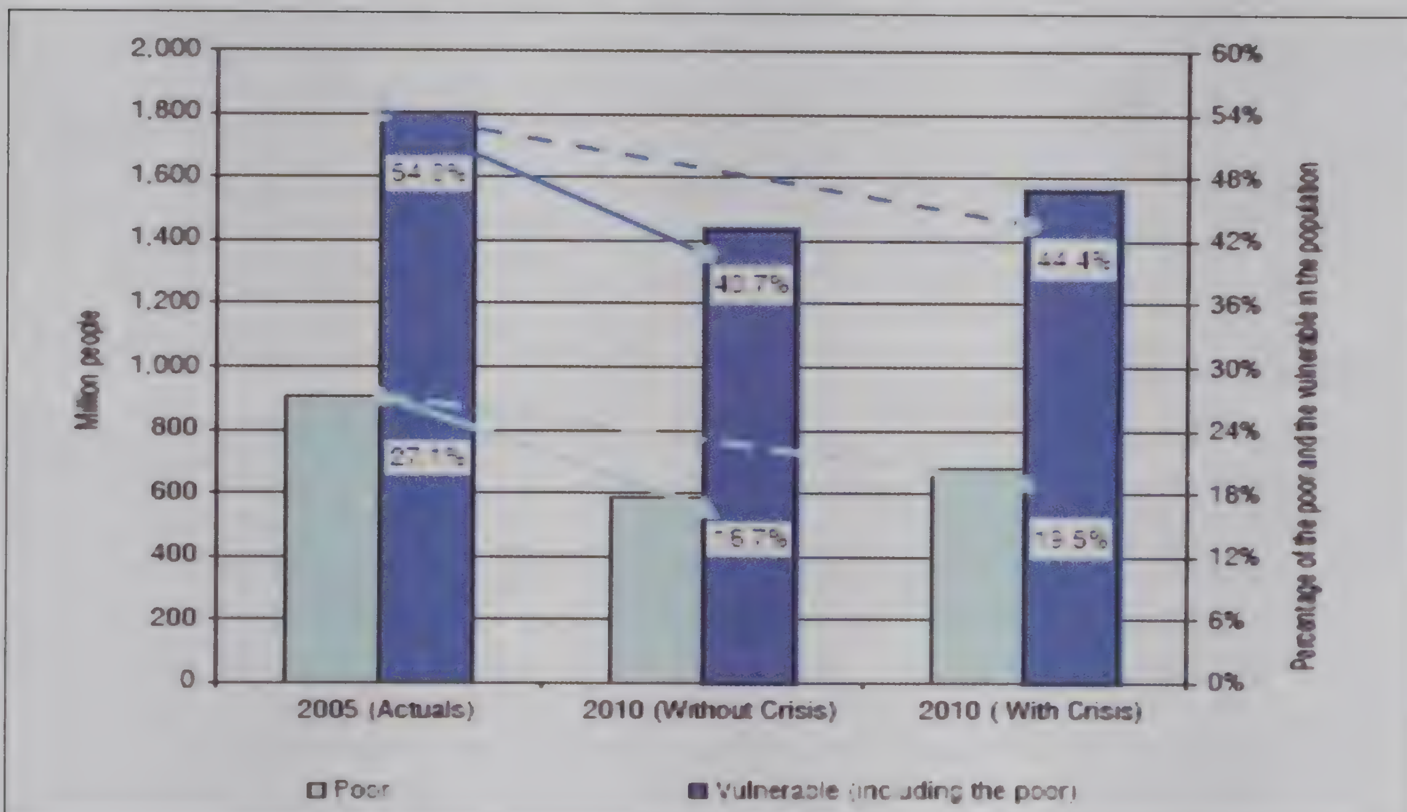
Ex-ante assessment

There is another way to assess the impact of the present crisis by comparing the GDP growth projections before the crisis and the revised projections computed when the crisis had already started. The difference in GDP growth projections before and during the crisis gives us an estimate of the impact of the crisis on economic growth and incomes. The projections show the shock impact of the crisis on GDP, with a significant reduction in the GDP annual growth (except in Sri Lanka, which may benefit from a peace dividend) (Figs. 4). This reduction in economic growth will have an impact on poverty *(3)*. In 2005 in Asia, before the crisis, it was expected that between 2005 and 2010, the number of poor in the region would be reduced from 27% to 16.7%, and the number of vulnerable people would be reduced from 54% to 40%. With the crisis, there would still be 19.5% poor people, and the vulnerable populations will still be 44.4% (Fig. 5). This means that for developing Asia as a whole (excluding central Asia), the recession is estimated to prevent some 64 million people from stepping out of poverty under the $1.25/day poverty line, and an additional eight million people remaining or falling below the $2/day poverty line. These 64 million are not the people who become poor but they are the ones who will remain trapped in poverty because of the crisis.

Fig. 4: Growth shocks

Country	Projected GDP per capita (% annual change)					
	Baseline		Revised		Diff = revised Š baseline	
	2009	2010	2009	2010	2009	2010
China	8.7	8.2	5.5	6.5	-3.2	-1.7
Bangladesh	4.7	4.2	3.8	2.2	-0.9	-2
India	5.8	5.9	3.4	4.8	-2.4	-1.1
Sri Lanka	5.5	4.7	2.1	5.3	-3.4	0.6
Pakistan	4.6	3.8	-0.7	0.6	-5.3	-3.2
Indonesia	4.5	4.3	-2.4	-0.5	-6.9	-4.8
Malaysia	4.9	3.8	-4.8	-0.8	-9.7	-4.6
Philippines	3.7	3.1	-2.3	-0.1	-6	-3.2
Thailand	3.9	4.1	-5.1	1.2	-9	-2.9
Vietnam	7	5.1	-0.7	0.1	-7.7	-5
Asia*	5	5.6	-0.3	3.1	-5.3	-2.5

Fig. 5: Impact on poverty and vulnerability in Asia



Impact of the crisis on health and education spending

In most countries in the region, spending on health and education will be reduced for both public and private expenditures (Fig. 6). However, what is important to note is that reduction in public expenditure for education is expected to be less than the reduction in public expenditure for health. This is because of what economists call elasticity. Elasticity is a ratio comparing changes. G. Wan has

compared the differences in spending (for education or health) with the difference in GDP growth *(1)*. If the ratio is positive, it means that an increase (decrease) in GDP growth is accompanied by an increase (decrease) in spending.

Fig. 6: Long-run vs Short-run Impacts

	Spending elasticity of growth	
	SR	LR
Private health	0.91	1.02
Public health	0.73	1.15
Public education	0.19	1.09

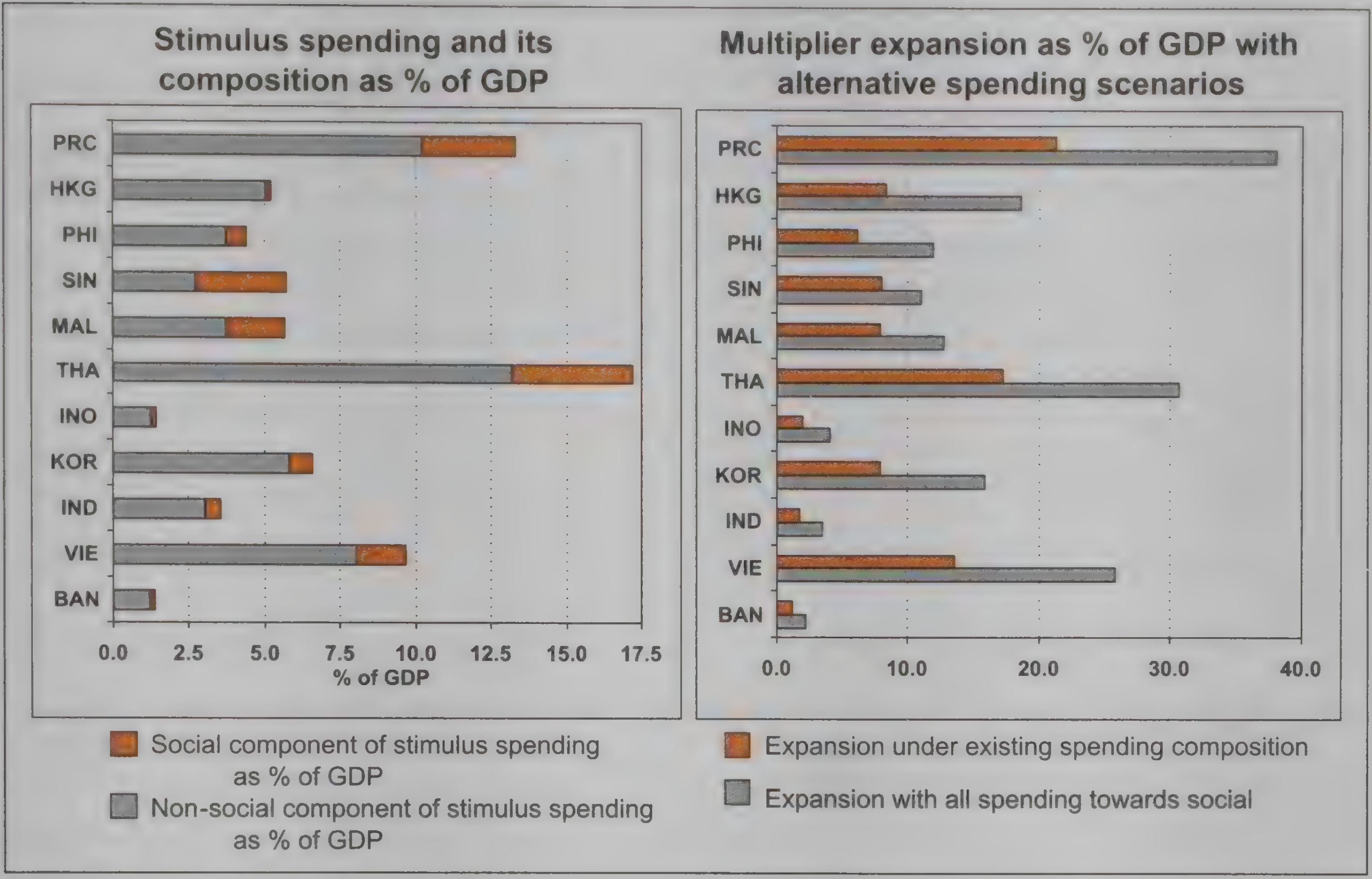
The value of elasticity is important. For example, Wan has observed that elasticity for health is greater than elasticity for education. As a result, a decrease in growth will affect spending for health more significantly than for education (and if growth increases, spending for health will increase more than spending for education) (Wan's paper describes how elasticity is computed *(1)*. Because elasticity for health is greater than elasticity for education, then if a household has a reduction in income, the household will try to maintain its expenditures on education but will decrease its health expenditures in the short term. It is the same for the government: elasticity is very low for public education. In the short term, if income is reduced, education expenditures will be protected (low elasticity) but health expenditures will probably be reduced (higher elasticity). This observation is important: during an economic crisis, governments and donors should make a conscious effort to protect health expenditures for the poor. In the longer term, the poor will require assistance for both health and education.

Response to the crisis

In response to the 1997-1998 crisis, governments in Asia introduced macroeconomic and fiscal reforms and political reforms (such as decentralization in Indonesia). The International Monetary Fund (IMF) and other international organizations recommended to governments to control budget deficits and reduce expenditures to re-establish investors' confidence and bring back foreign investments.

When the present crisis hit Asia, most countries were better prepared and several of them had sufficient resources (i.e. enough fiscal space) to rapidly implement fiscal stimulus programmes. Governments thus have responded very differently to this economic crisis and seem to have adopted just the opposite responses compared with their responses in 1997-1998. Governments, supported by international organizations, have adopted counter-cyclical investment policies. They have invested in what is called fiscal stimulus. Fiscal stimulus also covered social expenditures (Fig. 7); most countries have protected social and health spending, with some countries (China, for example) even increasing health spending.

Fig. 7: Responding the crisis – stimulus spending



It is important to consider the composition of the fiscal stimulus. If money is given to someone who has nothing, that person is going to spend the money. Household spending will have an immediate impact and further stimulate GDP growth. If money is given to everyone, or if the fiscal stimulus is used for infrastructure development, its impact will not be immediate. Fiscal stimulus can achieve even more (increase GDP annual growth) if spent on social issues. This is what the economists call the multiplier effect (Fig. 7, right side).

Real-time health impact assessment

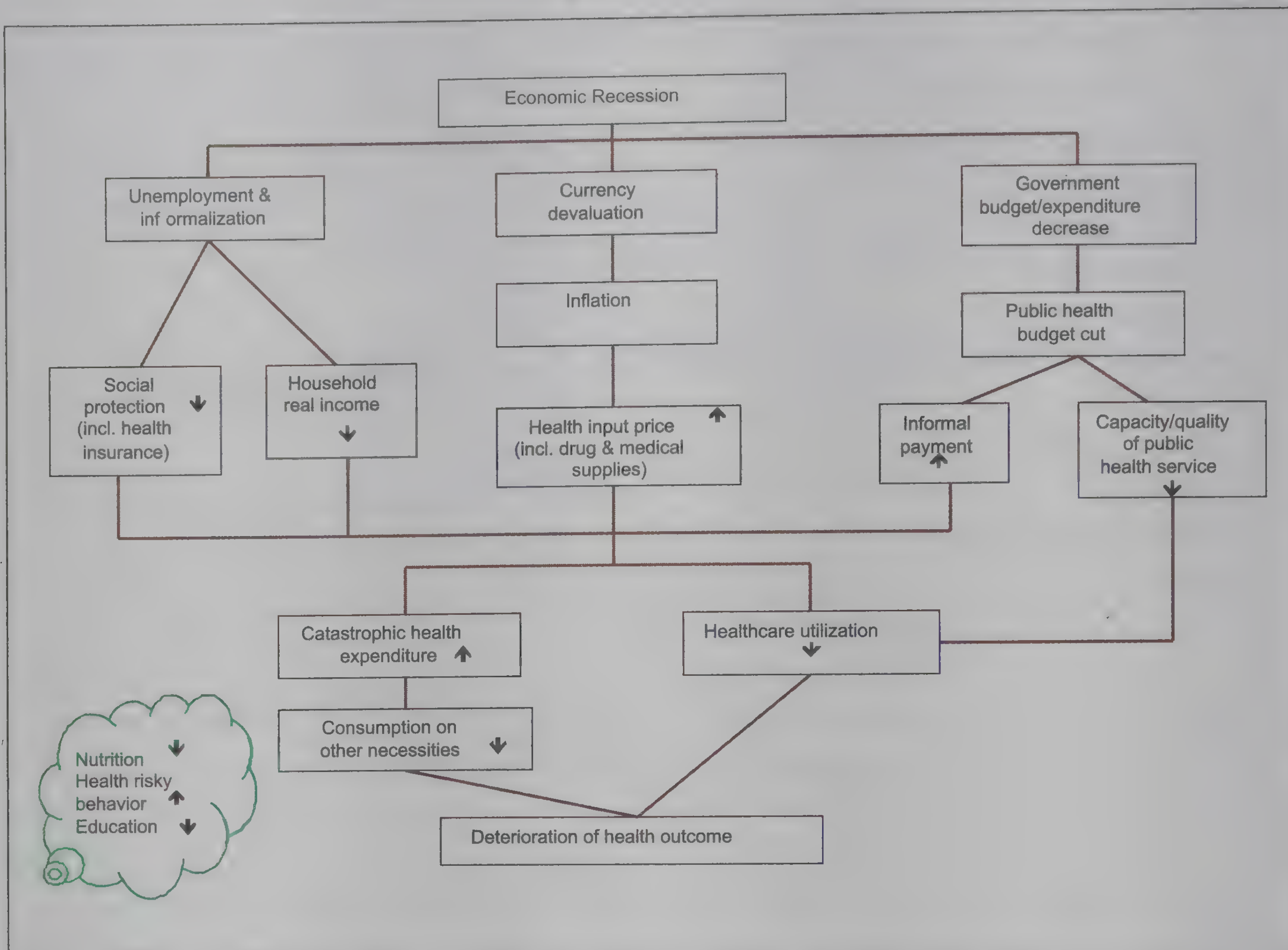
The impact of the economic crisis on health can be studied using the model of Professor Soonman Kwon and his collaborators (Fig. 8) *(4)*.

In an economic crisis, health care service utilization and expenditures for health will decrease (greater elasticity of health expenditures). Because public health budgets crash, there is a reduction in the capacity and quality of public services. Informal payments increase, meaning that the patient will have to pay.

The economic recession increases the prices of drugs and treatment because drugs are often imported. India may be fortunate because they are producing drugs but many other countries do not produce but import drugs. If there is devaluation in currency, that will also increase the cost of drugs and other medical supplies.

The economic recession has an impact on employment. The number of people unemployed or in the informal sector increases. With unemployment or moving to the informal sector, people often lose social protection; for example, health insurance. The crisis reduces households' real income and so decreases health care utilization. People who do not have money wait longer before they go to health services. People are no longer treated and there is an increase in catastrophic expenditure. People, whose income is reduced, do not only seek less health care but also change their consumption patterns

Fig. 8: Framework



and buy cheaper food, with an impact on their nutrition status, especially for children and women. Instead of buying meat, they will buy only the staple food. Consumption and other necessities would be reduced. Acute and chronic diseases increase. These factors will result in deterioration of the health and nutrition status. In 1997-1998, there were problems of mental health in Japan, Korea and Hong Kong SAR. There was an increase in the number of sex workers in Thailand because of poverty.

In order to assess the impact of current crisis, Professor Kwon and his team carried out a quick survey in Bangladesh, China, Malaysia, Nepal and Viet Nam. The team selected small samples of the populations that were probably directly affected by the crisis considering the structure of the economy. In Bangladesh, for example, workers in garment factories were surveyed.

Let me make a parenthesis here: it is not easy to estimate the impact of the crisis on an industry. Bangladesh, for example, has an important garment industry. Some economists contend that the crisis will have a huge impact on Bangladesh because the garment industry is an important source of revenue and the country relies heavily on exports. However, other economists believe that because Bangladesh is producing cheap garments, it will increase exports and thus benefit actually from the crisis. As you can understand, both hypotheses are reasonable.

Back to Professor Kwon's quick survey, the results show that in the groups surveyed in Bangladesh, China and Malaysia, workers who became recently unemployed were more stressed and depressed than the ones employed. But other indicators of health utilization, at this time, show virtually no change and no impact on health. (Data are not available for Nepal and Viet Nam).

Recommendations

Monitoring and evaluation

This quick survey is far from ideal. The team faced many constraints, such as the size of the sample and the difficulty to reach the unemployed within the time limits allocated for the survey. Therefore, it is necessary to continue monitoring the impact of the crisis. Monitoring and evaluation of economic and health data is essential. Monitoring is needed to see what is changing because of the crisis and what is changing because of programmes. It is thus important to identify and monitor indicators that will help determine how effective governments' responses and policies are in addressing poverty and mitigating adverse impacts on the health of the poor.

Health system strengthening

In general, health systems need to be strengthened to facilitate accessibility and quality of services.

Social protection

Another important recommendation is the need to strengthen safety net in general. Social protection is needed for the elderly and children and for woman-headed households. Health insurance only is not enough. Even with health insurance, people and children in particular may not get appropriate health services. For example, a mother who has to go out to earn some money cannot go to the hospital even if she has health insurance. Social protection needs to be comprehensive.

Asia needs more attention to social protection because poverty is still high. There are over 900 million people living in extreme poverty. Health crises such as pandemics and catastrophic health events cause premature death of the main earner. The poor have high vulnerability to risk but lack access to means of mitigation and coping. The share of the elderly population is increasing rapidly due to increase in life expectancy and decrease in birth rate. There is increase in urbanization which is linked to the disintegration of the family and the community networks. These were the networks that were supporting and protecting families. And now there is increased frequency of economic shocks due to globalization. Global warming also affects our region: earthquakes, typhoons, flooding, drought, etc., have also an impact on the health of the poor.

Asia is developing fast and has the means to develop social protection programmes. GDP spent for social protection in Asia is very low, most often below 5%. Tax/GDP ratio in Asia is also low. It means that tax collection can be increased without significant impact on most people. These additional resources should be allocated to social protection. Most countries in Asia can afford to have a social protection system. Some countries are doing it. India has started the National Rural Employment Guarantee Scheme. Thailand has the Universal Health Care Scheme. China aims at covering 90% of the population with health insurance within three years. There are programmes of conditional cash transfer in Bangladesh, Cambodia, Indonesia and the Philippines. These programmes just need to be further expanded.

Partnerships

First, let me emphasize the role of the private sector. Either because of direct interest (to maintain private sector activities, consumers are needed) or because of corporate social responsibility, the private sector is ready to work with us to mitigate the adverse impacts of the crisis on the poor and vulnerable populations. I do not have the time to expand on partnership with the private sector, but I wanted to mention it.

We should also reach out to other sectors. Multisectoral partnerships are needed to face the economic crisis. The problem of diarrhoea cannot be solved by the health sector alone. Morbidity due to road accidents cannot be reduced only by the health sector. If the health sector wants to address road safety, then the involvement of engineers is a must. The role of health professional is to identify issues by checking on mortality and morbidity, etc. Epidemiologists need to identify the mechanisms that will have the impact. Solutions to major health issues may lie in other sectors; thus, a dialogue must be established. People think differently. Epidemiologists must learn how people in other sectors speak and what their arguments are. Health professionals should learn how others consider health problems so that there can be a real dialogue. Epidemiologists need to learn how to talk with economists, other sectors, and with government. Do not think that everybody understands epidemiology. Economists are going to invest in fiscal stimulus for social protection of the poor because it will help increase economic growth. Epidemiologists can join in. Even if the objectives are not exactly similar, working together for the social protection of the poor will eventually improve the health of the people.

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The use of epidemiological data to monitor and evaluate programme performance

James Chin

A basic public health question is: how effective or successful are infectious disease prevention and control programmes in reducing infection, disease and death rates? The answer to this question depends on: (1) how well a prevention/control programme implements the programme's preventive measures (i.e. programme performance), and (2) how effective preventive measures and/or treatment for a specific infectious disease agent may be. Programme performance is measured by how timely, competently and completely preventive measures or interventions are implemented. On the other hand, programme effectiveness or success is measured by reductions in infection, disease or death rates that can be specifically attributed to programme efforts.

The effectiveness of preventive measures for any specific infectious disease agent can range from being marginally effective to highly effective. In addition, the epidemiology and natural history of infectious disease agents are all uniquely different and the effectiveness of preventive measures for each agent can also vary greatly depending on when these are implemented, i.e. during the early part of an epidemic, peak epidemic, post-epidemic, or the endemic phase of transmission. It needs to be recognized that even perfect programme performance will not significantly reduce infection, disease and/or death rates unless available preventive measures and/or treatment are effective.

Evaluating the effectiveness or success of infectious disease prevention/control programmes therefore requires: (1) evaluating programme performance; (2) knowing the epidemiology of each infectious disease agent, including whether the incidence of new infections is increasing, decreasing or is stable; and (3) having effective preventive measures and/or treatment. This paper evaluates the effectiveness of global prevention/control programmes for measles, tuberculosis (TB), HIV/AIDS and influenza.

Measles

The effectiveness of a measles programme can be simply monitored and evaluated by routine surveillance data (measles disease and death rates) and routine programme data (measles vaccine coverage rates). The United Nations goal of reducing the number of global measles deaths that occurred in 2000 by 90% within a decade (i.e. by 2010) has almost been reached in 2009 by the immunization of nearly 700 million children through large-scale vaccine campaigns and increased routine immunization coverages. The only WHO region that may not reach this goal is the South-East Asia Region, primarily because of poor programme performance in India where less than half of annual birth cohorts have received measles vaccine*(1)*.

Tuberculosis

The effectiveness of TB programmes can be evaluated by routine surveillance data (incidence and prevalence of TB cases and deaths) along with routine programme data - number and percentage of TB cases placed on directly observed therapy (DOT) and successfully treated. WHO and the International Union against Tuberculosis and Lung Diseases (IUTLD) have developed very specific targets for the reduction of the annual TB incidence, prevalence and deaths by 2015. Based on routine surveillance and programme data, these targets will be met in most regions but may be missed in two - Africa and Europe, primarily because of HIV-related TB*(2)*.

HIV/AIDS

Evaluating the effectiveness of HIV/AIDS prevention and control programmes is challenging because (1) the HIV/AIDS pandemic is comprised of several relatively independent HIV epidemics involving different HIV risk behaviours; (2) these epidemics started and peaked at different times in different regions/countries; (3) prevention of epidemic HIV transmission requires elimination or major changes in HIV risk behaviours that are difficult to effect, and (4) much of these behavioural changes have occurred after epidemic HIV transmission peaked and annual incidence began to naturally decrease.

From its inception in the mid-1990s, Joint United Nations Programme on HIV/AIDS (UNAIDS) was focused primarily on the *ever-increasing and ever-expanding* global number of persons living with an HIV infection (HIV prevalence). For whatever reason(s), UNAIDS ignored global trends of new HIV infections (HIV incidence) up till through 2005. In April 2006, the *Lancet* published an article by Shelton et al. entitled "Has global HIV incidence peaked?" *(3)* Using estimates of HIV prevalence and simple modelling, the authors were able to show that the HIV incidence in many African countries had peaked by the early- to mid-1990s. In May 2006, UNAIDS informed the UN General Assembly that: "*Overall globally, the HIV incidence rate is believed to have peaked in the late 1990s and to have stabilized subsequently…*"

The Millennium Development Goal (MDG) 6A established in 2000 for HIV/AIDS programmes *(4)* was to "*have halted by 2015 and begun to reverse the spread of HIV/AIDS.*" If the MDG target was to stop the annual increase of new HIV infections, then this target was reached over a decade ago! However, UNAIDS is apparently not yet convinced that the MDG target 6A has been met since it concluded in late 2009 that: "*… It seems probable that by 2015, it will be possible to make a reasonable objective determination as to whether or not the HIV epidemic has been 'halted and reversed' at the global level.*" UNAIDS needs to clearly spell out what is meant by "halted and reversed" since, in the 2009 MDG report, UNAIDS clearly acknowledged that the global HIV incidence peaked in 1996 at about 3.5 million and has steadily declined to about 2.5 million in 2007.

Regardless of what the MDG target 6A may be, the critical question is: how much of the decreasing global HIV incidence during the past decade can be attributed to or credited to HIV/AIDS programmes? Some modellers of the HIV/AIDS pandemic have concluded that new HIV infections in a sub-population (risk group) may decline or level off due to saturation of infection in those persons with the highest HIV risk behaviours rather than to the efficacy of interventions, education and other public health measures *(5)*. This conclusion is supported by simple modelling of HIV prevalence in several different HIV epidemics that show that the annual HIV incidence peaked and started to decrease well before HIV prevention programmes were started (Figs. 1-3).

Fig. 1: Modelling the IDU epidemic in Yunnan, China

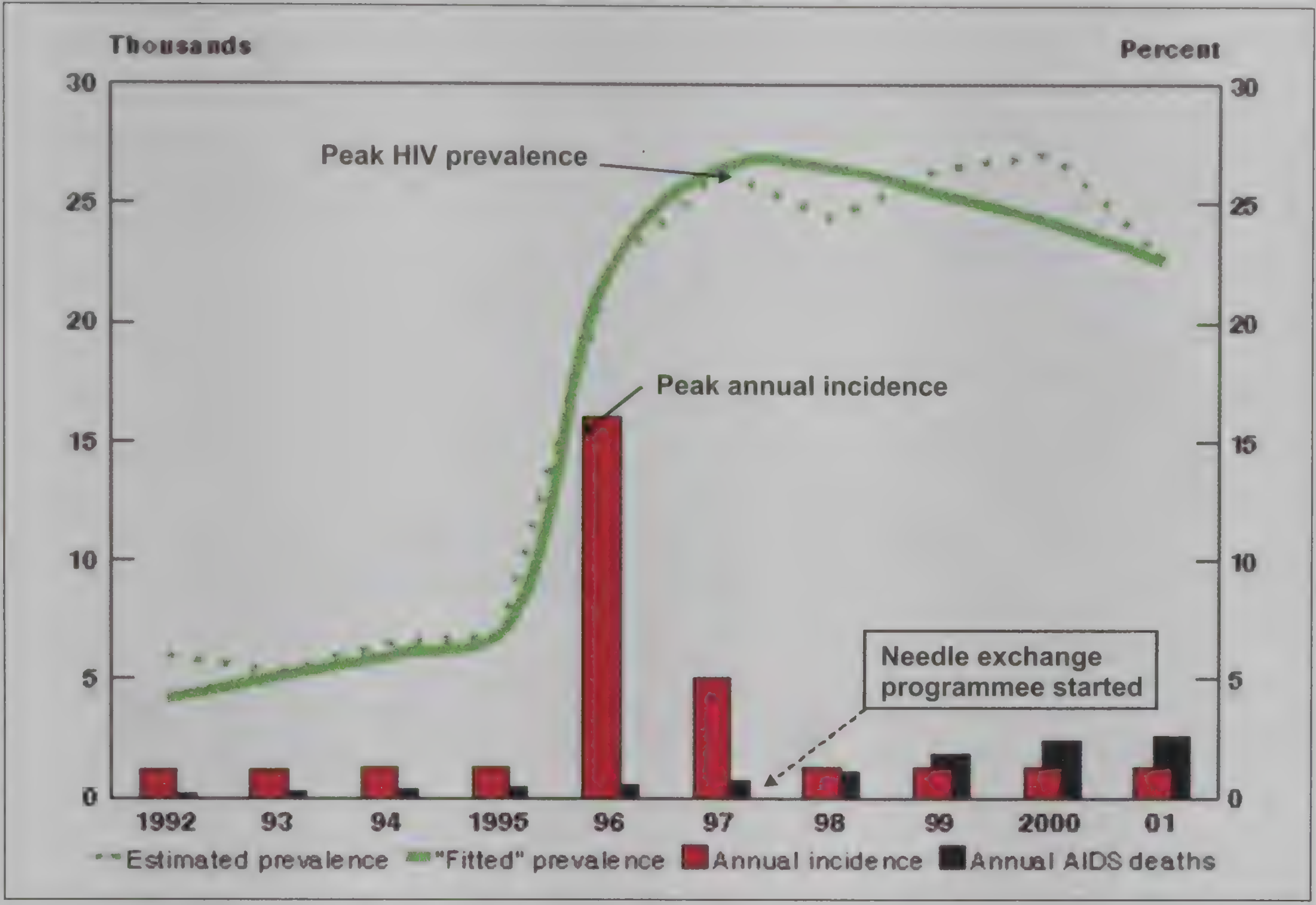


Fig. 2: Modelling HIV/AIDS in Cambodia

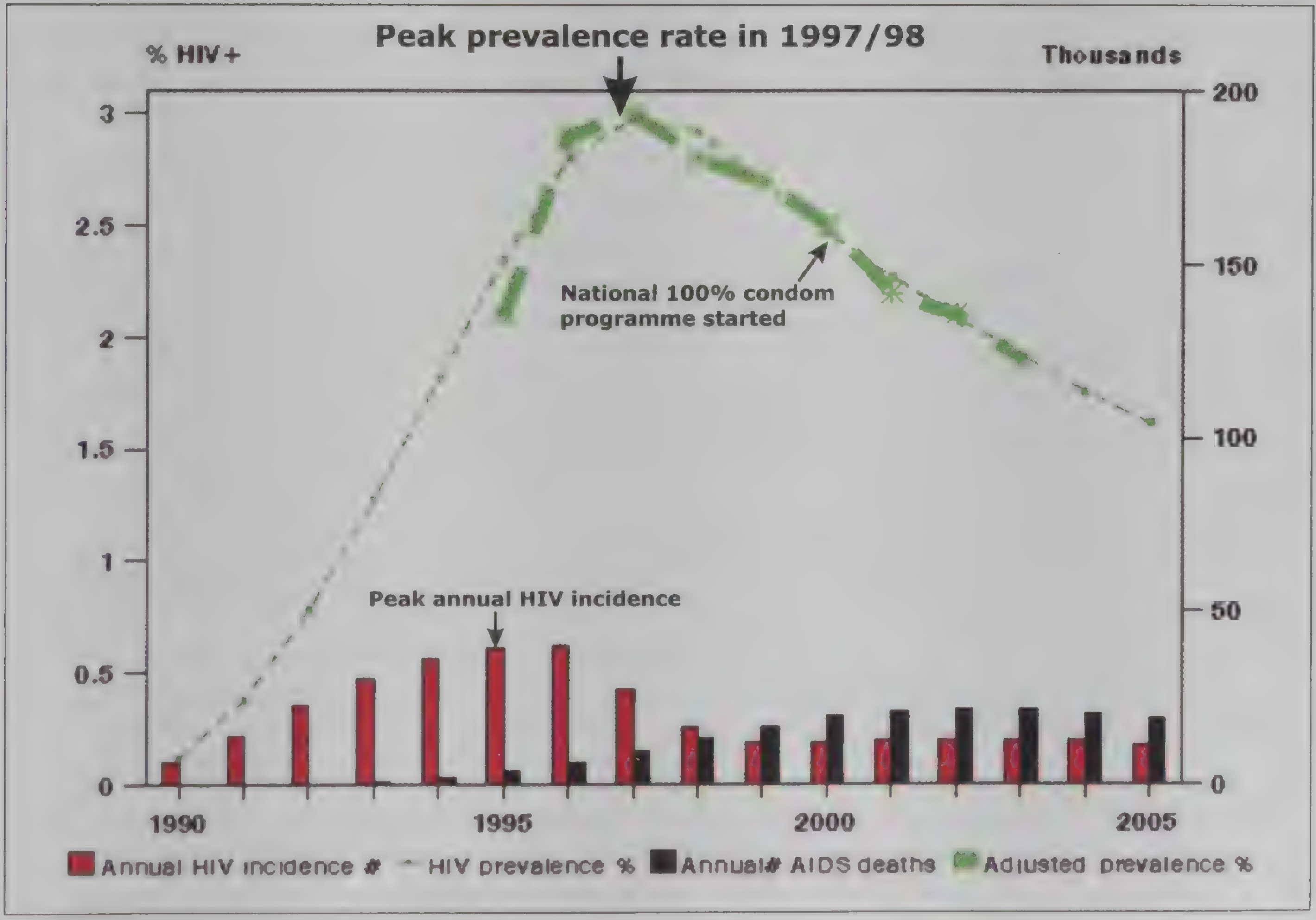
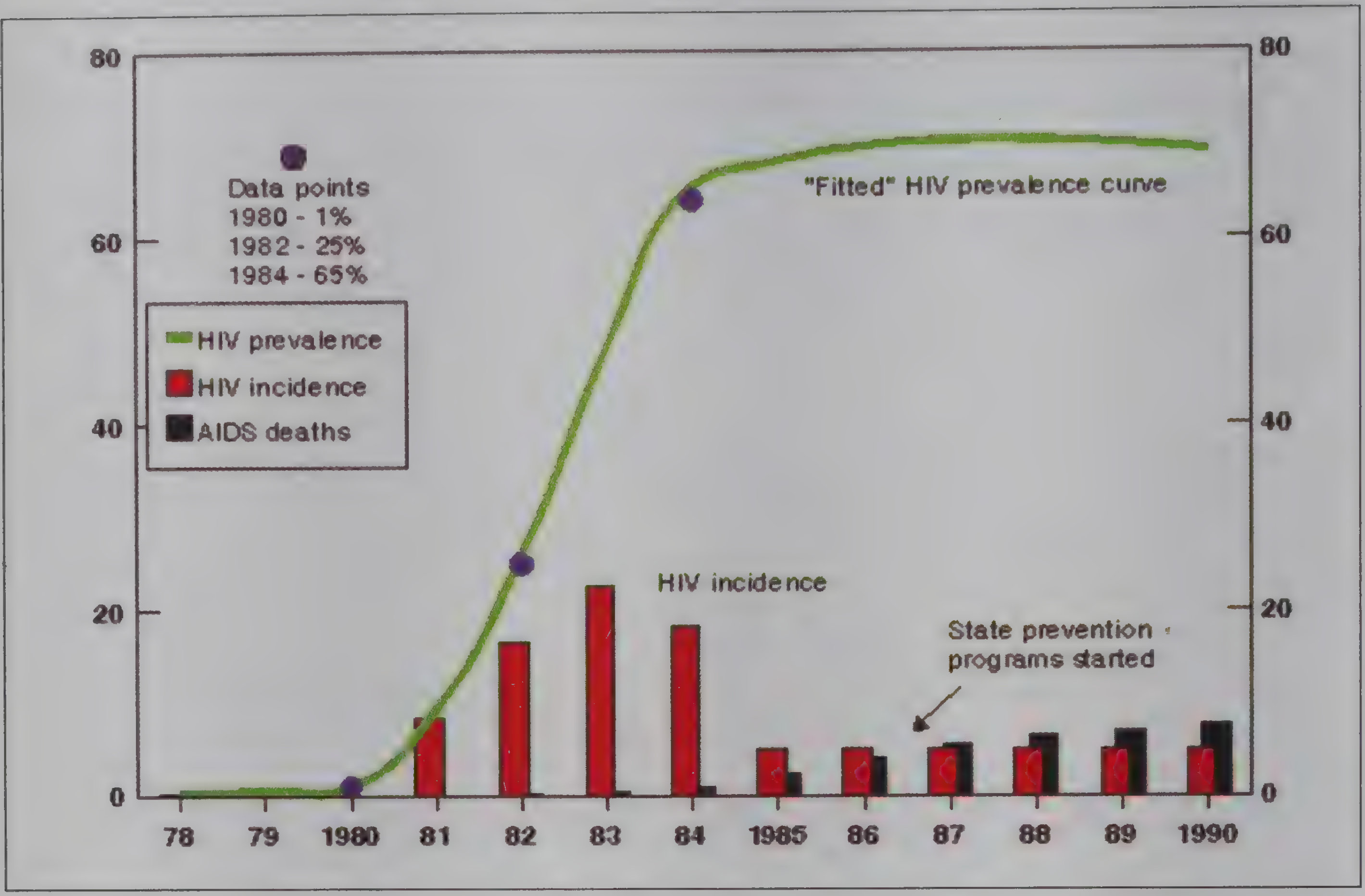


Fig. 3: Modelling the HIV epidemic in a SF MSM cohort



On the basis of an underlying logical framework and mathematical models, UNAIDS has correctly concluded that the AIDS programmes have contributed to a reduction in HIV incidence and AIDS mortality. However, UNAIDS has also cautioned that before a specific attribution can be made, an understanding of the dynamics of HIV epidemics and the variety of factors that contribute to HIV transmission and AIDS mortality other than HIV interventions is required to adjust for potentially confounding and contributory factors*(6)*.

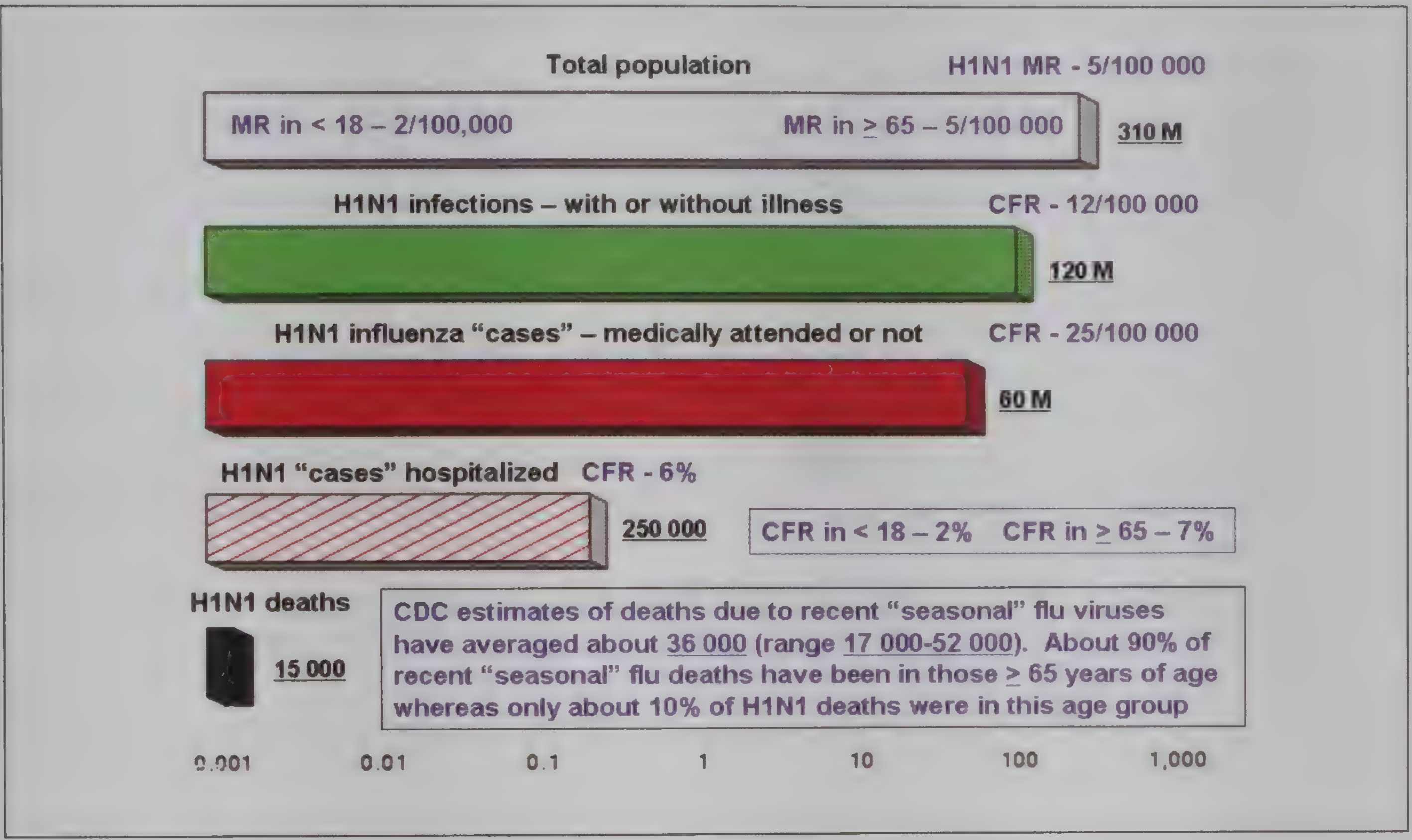
Influenza

Evaluating the effectiveness of influenza prevention/control programmes is even more challenging than evaluating the success of HIV/AIDS programmes since new influenza viruses pose a constantly changing and moving target for prevention programmes. A new potentially pandemic influenza virus can emerge suddenly but the severity or potential impact of any new influenza virus can only be measured as it spreads through populations. All influenza viruses are different with regard to their (1) ability to spread in human populations; (2) antigenic differences and similarities to previous seasonal or pandemic viruses; (3) clinical spectrum of disease, and (4) mortality rate. (7-9)

Estimates of influenza case-fatality rates (CFR) are difficult to use to compare the severity of influenza viruses because the definition of a 'case' of influenza has not been well defined and can range from all infections to only those infected persons who are hospitalized. Estimates of influenza mortality rates, in a defined population, of pandemic and recent 'seasonal' influenza viruses can provide a reasonably objective yardstick to assess the relative severity of any new influenza virus. However, at the outset or beginning of a new influenza pandemic, the severity of any new influenza virus is unknown. This makes it virtually impossible to estimate what impact, if any, public health interventions, whose effectiveness are also unknown, may have on a new influenza pandemic.

The Centers for Disease Control and Prevention (CDC), USA, has estimated influenza deaths from 'seasonal' influenza viruses over the past decade with a statistical extrapolation model using influenza surveillance data, death certificate data and special virus surveillance data *(10,11)*. According to the CDC model, annual influenza deaths in the USA in recent years have ranged from 17 000 to 52 000 with an average of 36 000 or a mortality rate of about 12/100 000*. As of March 2010, CDC estimated less than 15 000 deaths or a mortality rate of less than 5/100 000 due to the 2009 H1N1 pandemic virus, which is less than the lowest mortality rate estimate of recent 'seasonal' influenza viruses (Fig. 4).

Fig. 4: Estimated 2009 H1N1 numbers and rates - USA



The effectiveness of public health measures to prevent or limit the spread and impact of influenza viruses in human populations has not been established. These measures have included travel bans/ restriction from infected areas, quarantine and isolation of travellers from infected areas, routine school closures, cancelling or limiting public gatherings, routine use of face masks and hand hygiene and disinfection of surfaces. These measures were not all uniformly or consistently implemented and collectively they may have, at best, slowed the spread of the 2009 H1N1 virus in some populations. The 2009 H1N1 influenza vaccine may be 70%-80% effective in providing some personal protection against the new pandemic virus, but large supplies of this vaccine were not available until the pandemic had almost peaked.

Thus, even if influenza programmes performed well, it is difficult to estimate how many H1N1 influenza deaths might have been prevented by the prevention/control programmes.

* In late August 2010, CDC revised its "average" estimate of US deaths due to seasonal influenza from 36 000 (MR 12/100 000) to 24 000 (MR 9/100 000) by including estimates starting from 1976 instead of from 1990.

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Section 4

Parallel Sessions

Parallel Session 1

Epidemiology and public health emergencies: the critical need for preparedness and response

Chairpersons: *Poonam Khetrapal Singh*
Mahmudur Rahman

Session Coordinator: *Roderico Ofrin*

Facilitating appropriate response in disaster: the role of epidemiology
– *Roderico H. Ofrin*

Laboratories as essential component in public health emergencies – *A C Mishra*

Risk communication: challenges in Pandemic H1N1 2009 response: Thailand experience – *Supamit Chunsuttiwat*

Facilitating appropriate response in disasters: the role of epidemiology

Roderico H. Ofrin

The use of properly collected and analysed information as the basis for any public health programme, activity or policy is a key process in public health practice. An emergency or disaster, despite the complex environment and the urgency of interventions that need to be undertaken, is not exempt from this important course of action. The methods used in applying the principles of epidemiology and the means used to collect and analyse data present many challenges. A clear understanding of the strengths and limitations of these methods will support better decision-making among all stakeholders in a health crisis to implement more appropriate and efficient responses.

The focus of this paper is to look at the use and application of epidemiology during the response to an emergency. It does not discuss epidemiology in other phases of disasters and emergencies such as preparedness, risk reduction, recovery and rehabilitation. As such, the paper focuses only on three methods in which health information is collected, analysed and interpreted to translate it into action.

Various methods, their use and relationships

The three methods of health information collection are: 1) rapid health assessments; 2) surveillance; and 3) surveys. Their characteristics are presented in Table 1.

Table 1: Comparison of various types of methods of collecting information during emergencies/crises

Methods of information collection in emergencies/ crises	Focus	Aim	Limitations	Other characteristics
Rapid health assessment (RHA)	Measure the health status to forecast future health risks, and identify those needs of the affected population that require immediate response	Validity. Address immediate needs and identify urgent actions	Has to rely on subjective judgement aside from objective sources of information	Not routine. Needs to be organized and set up

Surveillance	Continuous collection and systematic analysis and interpretation of health data for planning, implementation and evaluation of public health actions	Sensitivity. Prevention and control of diseases	Based on numerators most often as denominators fluctuate rapidly during crisis	Routine. Ongoing activities and protocols are set; must focus on major health problems but also need to be flexible to adapt to fluid situation of emergencies
Surveys	Assess the severity of the crisis and identify health priorities for interventions (and impact of those that are ongoing)	Validity and precision. Sharpen interventions and address health priorities	Susceptible to biases (e.g. due to various reasons - tools applied, sampling methods used, cultural differences)	Not routine. Needs to be organized and setup

With the issues presented in the table above, there is a need to see the relationships and complementarities of information/products collected through all three methods. A rapid health assessment can intensify and sharpen an existing surveillance system. Both rapid health assessments and surveillance can support the conduct of surveys. They can provide a good starting point for the focus needed for a survey to be planned or conducted. In turn, a survey can refute or validate the initial findings of a rapid health assessment and help further calibrate a surveillance system.

Health intelligence: interpreting in context and addressing needs

It is important to take forward information gathered in context so that there can be a solid basis for decision-making and proper action can be derived. Looking closely at the findings of these aforementioned methods and linking them with the existing information systems as well as census data can provide a very good epidemiological base for actions that need to be taken in an emergency.

From all these three methods, the analysis of secondary data — some of which may or may not be health-related (e.g. socio-political background of the affected area; water and sanitation coverage of the location of the displaced) — would clarify the context of the situation and provide the basis for decision-making. These decisions are to be taken by service providers and facilitators of action such as ministries of health, national and subnational authorities, partners such as WHO and other UN agencies, NGOs and international donors. A meaningful interpretation of health information gathered can provide a clear guide on what assistance, if any, they should provide.

A critical aspect of using health information and epidemiology collected in emergencies is also about interpreting these as needs. It is important to identify and describe needs as follows:[1]

- Needs against measured health problems (e.g. potential increase in cases of diarrhoea among those displaced by a flood);

1 Adapted from James Darcy and Charles-Antoine Hofmann. Humanitarian Needs Assessment and Decision-Making, Humanitarian Policy Group Briefing. 13 September 2003.

- Needs against an existing gap (e.g. not enough oral rehydration salts (ORS) supply to address this potential increase in diarrhoeal cases);
- Needs with a humanitarian perspective (e.g. population affected by floods needs supplies/ medicines as aid to counter the potential increase in diarrhoea cases).

Then and only then can rapid health assessments, surveillance and surveys be considered as intelligence and meaningful.

However, in an emergency situation it is not so simple as several questions will arise: How much ORS is needed? Who will provide the funds? Where will this be bought? How will this be transported to the affected area/people? Who are the others who can act on this information? Are there health workers who can distribute ORS properly? Who else might have already bought ORS as part of preparedness or response?

Challenges

From the questions presented above, it is clear that discussing epidemiology in emergencies without describing the chaos of the environment in which it will be applied reduces the topic to an academic exercise. A few challenges are mentioned below:

Coordination

In any emergency, numerous NGOs and agencies are usually present and work on health issues. In Aceh, Indonesia, for instance, there were over 250 NGOs in the health sector alone; during the cyclone Nargis in Myanmar in May 2008, over 80 NGOs were engaged in health work, and in the recent earthquake in Sumatra, Indonesia, in September 2009, there were around 40 NGOs providing assistance.

A part of the agenda or main work of all agencies is to gather information and conduct rapid assessments and surveys; they also participate in surveillance systems that are in place or set them up. As such, information-gathering is often duplicated, resulting in varied interpretations. These can also lead to gaps in actions/interventions.

Post-tsunami (December 2004), an effort to reform humanitarian practice was set in place by the United Nations. Since 2005, the international response is done through the cluster approach and WHO is the lead agency for health. The emergency of cyclone Nargis specifically had a subgroup which coordinated participation in joint surveys and surveillance so that the methods were consistent and analyses meaningful. The post-Nargis Recovery Plan Survey remains as the template in joint post-emergency assessment - where over 100 agencies and thousands of volunteers drew up a plan, method and training, and the analysis for the survey was achieved and implemented. The health cluster is a way to coordinate information-collection in such a way that it is implemented in a structured manner, with cooperation from all agencies involved.

Changing context

The setting in a crisis is always in a flux and this brings challenges to information- collection, affecting application of epidemiology. The following changes can occur:

- Expansion of the emergency area from local to regional or countrywide or can extend outside camps as the case may be;
- Field conditions such as lack of security and accessibility and problems of logistics which can hinder access to information;

- Changes in the affected populations which would make conduct and interpretation of surveys more difficult.
- As a result, trend analysis becomes difficult and there are no baseline data for comparison. Furthermore, the aggregation of findings from subregional data to a context-wide result is not straightforward (meta-analysis is seldom applicable).

Differences in methods applied

Due to the challenges explained above, differences in the methods applied often occur. Some examples encountered are:

- Inconsistent population data for determining the sampling frame;
- Lack of guidance on sample-size calculations and data analysis procedures;
- Lack of a standardized question set/tools that can be applied within/between observer variation;
- 'Survival bias', for example, when households in which all under-five children have died are excluded then there is an underestimation of mortality;
- Cultural differences and language barriers can hinder the accuracy of findings of assessments/surveys/surveillance.

However, it is noteworthy that since the inception of the cluster approach, agencies involved in humanitarian health response have progressed in getting common tools for assessments [initial rapid assessment (IRA) and monitoring of health response (HeRAMS)].

Conclusions

In view of the foregoing, the following conclusions can be drawn:

1. For methodological issues in emergencies, solutions lie in better operational modalities such as strong coordination of responses.
2. The central focus for preparedness of the health sector should be:
    a. a consensus on methodologies that will be applied for assessments and surveys during emergency response;
    b. strengthening existing surveillance systems and a protocol for early warning systems during emergencies;
    c. pretesting and training for tools/surveys that will be applied during emergencies, especially those with a regular return (e.g. floods during the monsoon season).
3. Link the epidemiology of health issues and use of health information to a systematic monitoring and evaluation of health response during emergencies/crises/disasters. Only through this can true lessons be drawn and substantiated in such situations, leading to a better response to future events.

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Laboratories as an essential component in public health emergencies

A. C. Mishra

Public health emergency means an occurrence, or an imminent threat, of an extremely dangerous nature, caused either by a toxic or biological agent, that may do substantial harm to population. Public health emergencies raise several issues. Declaration of an emergency is the first necessary step because that authorizes the start of examining and testing people, which is linked to the issue of isolation and quarantine. Then there are issues of the evacuees, facilities and supplies, use of nongovernmental personnel, business continuity, treatment and vaccination, information-sharing, and safety of workers and community. Most of these actions cannot be initiated unless there is a laboratory confirmation of the cause of public health emergency.

Emergencies are classified into various types: the disaster-related emergency and public health emergency. Exposure to dangerous conditions due to intentional release of a risk agent, i.e. bioterrorism, is another type which is always at the back of the mind of any organization or country. Preparedness of laboratories for such an emergency becomes very essential. Most often, natural emergence of epidemics or pandemics are the major emergencies, which have occurred frequently in the past.

Laboratories are not the primary responders in an emergency. However, laboratory scientists are very important people who have to confirm the cause of emergency before anybody else starts any action. That means if something happens, it is the epidemiologists and other personnel who have to reach the site. Then comes the laboratory. However, all actions can remain on hold till a confirmation of the cause is received from the laboratory. It is very clear that laboratories are not the primary responders. In some countries, these roles are not very clear. Laboratory scientists are also asked to respond first. Hence, laboratory personnel may have to play both the roles, especially those laboratories which have advanced levels of diagnostic facilities.

There are mainly two or three types of laboratories. The laboratory needed for the bioterrorism response is called chemical, biological, radiological and nuclear (CBRN) laboratory. Every country has a programme on CBRN laboratory. It includes chemical detection and testing, biological testing, and radiological and nuclear detection. Specialized laboratories are meant to deal with other pathogens that are not part of CBRN. These are specialized virology and bacteriology laboratories.

In the disaster-related emergencies, habitat gets changed because of flooding or earthquakes and animal and human interface gets disturbed. Most of the rodents and other vectors that are in that area move to another habitat, and, because of this change, often there are disease outbreaks. In these kinds of emergencies, laboratory has some time to prepare in advance because it should be able to anticipate on the basis of whatever has happened. There are five or 10 days before an outbreak actually occurs. For example, following floods, leptospirosis or other diseases may occur but the laboratory gets some time to prepare itself. The situation is often not simple because the agents that may need to be dealt with are not the agents that the laboratory normally deals with. Hence, it becomes very challenging.

In bioterrorism-related response, there are four kinds of mishaps that laboratories have to prepare themselves for, i.e. chemical, biological, radiation or nuclear. Chemical radiation and nuclear exposure are different from biological exposure because, in such cases, detection is the most important aspect and there are hand-held tools which can be mounted on a vehicle and it takes little time to find out what has happened. In biological exposure, this kind of detection system is not available. In biological response, complex detectors are either not available or are unreliable. Severe potential bioagents are endemic in nature and they exist in one form or another. One has to distinguish whether they are intentional or are naturally occurring ones. Rapid identification of the bioterrorism agent is important, particularly for criminal investigations and later for management and evacuation. Laboratories have to play this role, hence they have to be prepared. A national-level laboratory has to play this role.

In the area of novel pathogens or re-emerging pathogens, laboratories have an important role to play. In an outbreak that occurred in 2001 in Siliguri (India), a team of investigators from National Institute of Virology (NIV), Pune, found it intriguing. The outbreak was very explosive in nature. Adults with fever were coming to different hospitals in Siliguri during January-February; 68% of them were health care workers, and the case fatality was 74%. This was an unique outbreak where such a high percentage of adults and health care workers had died. It was a major dilemma for the NIV staff. How to handle such a situation? Laboratory personnel working in the field for sample collection were told to collect whatever specimens they could get themselves. When they returned to the institute, nobody knew how to process the specimens because these could infect laboratory workers. The disease could spread in Pune because it was being transmitted easily to adults. This outbreak became a stimulus to develop three first-level bio-safety laboratories.

Frontline testing was started for encephalitis syndrome but all tests were negative. PCR was not being done at that time. Samples were sent to CDC, Atlanta, USA, and they found antibodies to Nipah virus. Subsequently, some urine samples were tested which were non-conventional samples kept in our laboratory. PCR could be done in them as sequences were also known by then. It was an interesting interface between laboratory and epidemiology. Since 1999, this disease was known from Malaysia where sporadic cases like that of Japanese encephalitis had occurred. But, in Siliguri, it was clustered in hospital settings. Everybody tended to believe that it looked very similar to Nipah virus but it may not be so from epidemiological point of view. The diagnosis was held back for two years. It was only after the 2004 Bangladesh outbreak, which was very close to the Indian border, that India declared the Siliguri outbreak as caused by Nipah virus*(1)*.

Epidemiologically, it was the first time after the Indian outbreak when it was established that this kind of a cluster infection could occur. This is a good example to emphasize the need for an interface between epidemiology and laboratory. If laboratory comes up with some diagnosis which does not fit epidemiologically, the first doubt is whether it is contamination or not. The first question asked from the laboratory worker is whether he has this agent in his fridge. If he says yes, the decision is held back. Decision-making becomes very difficult and it is a matter of great frustration for the worker who may have done the test very methodically. Epidemiological information becomes very crucial. The Bangladesh and Indian sequences were in one cluster, i.e. they were quite different from the Malaysian sequences. A lot of pathological studies with laboratory experiments need to be done before one can give importance to these sequence differences. Subsequently, this disease has been reported in Bangladesh and India on several occasions.

Another example is the characterization of Chandipura virus. Acute encephalitis has been occurring in central India over the last 15-20 years. In 2003, there was an outbreak involving more than 300 people with more than 50% mortality *(2)*. Here, young children were involved. A team was sent for investigation. Most samples were negative for most of the known agents. As frontline tests failed to provide any lead, clinical samples were inoculated in several cell lines. One isolate grew very quickly. When looked in electron microscopy, it was a typical bullet-shaped rabies-like virus. At first

it appeared like rabies, which could be a contamination. Through further process, more isolation was found, and finally the reagents were developed. More than 50% of the cases were confirmed to be due to this virus. Subsequent studies after a year proved the occurrence of this disease in several other places in the states of Maharashtra, Gujarat and Andhra Pradesh. Thus, a very acute problem occurring for a long time in central India was resolved.

NIV has developed a vaccine for the Chandipura virus but there is no commercial interest in it as this disease has a limited spread. However, health authorities have become confident that at least samples can be tested, and if it is positive, they can declare the aetiology of the outbreak. PCR emerged as a frontline tool. Earlier investigations could not resolve the issue. PCR was able to detect in up to 60% samples. But the isolation test detected hardly 5% samples in the initial phase. Isolation is not easy. Once isolated, the growth of virus is very prolific. It can grow anywhere. In fact, it was used by many laboratories for demonstration purpose. A new development in technology can sometimes help to identify a disease which otherwise could have remained undetermined.

The pandemic potential of H5N1 had in a way done a lot of good to India because four outbreaks in different regions led to a substantially increased level of preparedness, which came handy when H1N1 appeared. The preparedness was also important as it brought about intersectoral collaboration. There was a good link established between the Ministry of Agriculture and Ministry of Health to face the problem together. The Health Ministry, in addition to looking after the health issue, also looked at the bird issue. Containment was considered a key strategy because H5N1 is not easily transmissible to humans but it caused huge mortality in chicken flocks. Culling of chickens could contain the outbreak. In fact, this policy of containment was kept in mind when the H1N1 outbreak occurred. The preparedness also included steps to deal with a virus in the laboratory which could kill 80% of those affected.

The first public health emergency of international concern declared under the International Health Regulations (IHR), which occurred in India in 2005, was H1N1. India confirmed its cases on 16 May 2009 and the first death due to H1N1 happened in Pune, Maharashtra. This created a serious situation. Suddenly, it was recognized that monitoring was to be done at the airport to contain the disease. However, soon this strategy was dropped and investigations for monitoring the local transmission were started. Many diagnostic centres were created. Seasonal flu virus and H1N1 were both active during that period. Seasonal viruses have gone down but H1N1 is still active. A very important observation in this outbreak was the different levels of severity in different areas *(3)*. In some places like Bengaluru and Pune, the severity was higher, but in Kolkata and Bangladesh, the virus activity was very low, with very few deaths. There were many differences even within the same city.

There was higher risk of hospitalization for the H1N1 virus cases in Pune. There were several deaths in Pune over a period of three months. It looked more like a function of the virus. The 50-60-year age group was more vulnerable but very few cases were found among people above 60 years of age. There was at least 11 times more risk of dying from this virus than from the seasonal influenza viruses. The severity was much higher in tropical developing countries like Thailand and Mexico than in the United States and Europe. About 10 000 serum samples were collected from the risk groups, and general practitioners were found to be most at risk (4). The evolution of the virus and drug resistance status has been studied (5). Some pre-clinical studies in mice have also been carried out. Four companies are coming up with a vaccine for humans. Soon, India is likely to have its own vaccine.

In summary, the role of advanced-level laboratory in a public health emergency is to detect the causative agent or pathogen, alert epidemiologists and physicians and provide technical advice to government. In all this, speed is important because everything has to be done in a limited time frame. If more time is taken then it defeats the purpose. Every laboratory must have a response programme.

It must ensure its ability to plan and respond to an emergency expeditiously. If an emergency has arisen, then the confidence that the laboratory has the capacity and ability to respond to it must be ensured. There should be a contingency plan. Laboratories must also have surge capacity because routine capacity may be limited. Another very important issue is that of quality control and the ability to produce standard reagents. There should be indigenous capability to produce important and critical reagents; laboratories cannot always bank on reagents supplied from elsewhere.

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Risk communication challenge in pandemic H1N1 2009 response: Thailand's experience

Supamit Chunsuttiwat

Thailand has experienced the first wave of pandemic influenza A H1N1 2009, and also had the second wave. In the first wave, about 13% of the country's population got infected. There were 28 036 confirmed cases with 184 deaths. Children and young adults were more prone to pandemic H1N1 2009 infections; however, people of older ages and those with certain health conditions, e.g. pregnancy, obesity and chronic heart and lung diseases, were at higher risk for severity and death.

The initial response to the imported H1N1 virus was marked by intensifying the surveillance, enhancing risk communication and activating multisectoral pandemic preparedness plans to detect cases and delay the spread of the virus. However, when local transmission had been stabilized, the response strategy was changed to mitigation. Mitigation efforts included extensive risk communication, promotion of hygiene and social distancing and intensified case management, all under the framework of multisectoral cooperation.

Role of risk communication in pandemic response

The experience gained from the response made to pandemic H1N1 2009 in Thailand obviously demonstrated that risk communication is its main cross-cutting strategic component. On the one hand, it is a major intervention to ensure public involvement in disease prevention and control; on the other, it serves as the work fabric that holds together other work components and keeps them in synergy.

As an intervention, risk communication keeps the public and partners in all sectors regularly updated on the outbreak situation, provides essential background information and helps clarify doubts about the nature of the disease, its prevention and treatment and other related aspects. To promote society-wide influenza prevention, especially when the time-specific prevention tool such as influenza vaccine is not available or is inadequate, risk communication serves as the principal means to convey essential messages on non-pharmaceutical interventions (e.g. hygienic practices and social distancing) to all public and community sectors. In the early phase of the pandemic, people's panic caused a sharp rise in hospital visits, resulting in overburdening of hospital staff and, therefore, a drop in the quality of medical service including the care of severe cases. To cope with the crisis, risk communication was formulated to inform the public on the nature of H1N1 infections and help convince them on home care for mild cases that represented the majority of H1N1 infections so as to reduce unnecessary burden on hospitals. However, in another extreme of disease pattern, certain groups such as pregnant women, obese persons and individuals with chronic diseases were at a high risk of severe illness and death from influenza. To protect these high-risk groups, specific messages were disseminated to encourage early medical care-seeking on the part of the patients and maintain awareness among medical professionals for early care of such individuals.

As a networking tool, information, eduction and communication (IEC) for pandemic response – of which risk communication is a main component – helps ensure knowledge and awareness about the pandemic among potential partners and keeps them updated on common policy, strategy, workplans and standards of practice. A good example of public health functions for which broad participation has been maintained by effective communication is disease surveillance. During the period April-May 2009, when the pandemic virus was getting introduced into the country, the effectiveness of case detection depended largely on the awareness and alertness of travellers to report to health authorities if they had developed influenza-like illness within a week of entry. Detection of early imported cases, as well as early clusters of locally infected cases, was enabled mainly by voluntary reporting by sick persons who sought medical care, and by alert medical personnel who saw the cases. This public alertness was significantly attributable to risk communication.

Risk communication in operation

Pandemic preparedness plans in all sectors have put considerable weight and expectation on risk communication. The National Pandemic Influenza Response Committee has set up a subcommittee to coordinate and monitor risk communication, and a similar arrangement has been put in place at subnational levels.

Crucial messages for different target populations, by and large, cover common areas – pandemic situation and risk, background knowledge of influenza, disease prevention methods with emphasis on non-pharmaceutical interventions, and care-seeking when ill. However, different emphasis and details are designed for different target groups; for instance, the recommendation for fever screening and staying at home during illness is stressed for schools and work settings, while advice on early care-seeking is aimed at persons with a high risk of severe illness.

Although mass media such as newspapers, radio and television and posters and signboards and Internet are the main channels for disseminating risk communication messages across a broad range of target populations, community-based communication is equally important and, in many situations, provides more effective communication and promises more sustainable health behaviours. Community-based communication as part of pandemic response in Thailand relies largely on the contribution of over 800 000 village health volunteers, community leaders, community action groups, NGOs as well as local health personnel countrywide. Besides the individual person-to-person communication that offers opportunities for interpersonal exchange and the flavour of human contact, various innovative means and models of community-based risk communication have been developed and implemented on a large scale. These include the use of home visits, village loudspeakers, village health posts, local drug stores, community dialogues, campaigns and exhibitions.

Risk communication challenges

The relatively rapid handling of pandemic H1N1 2009 in Thailand is attributed significantly to the work done in the dissemination of risk communication, and it is the result of vast contributions made by dedicated partners in various sectors. However, what has been done in this area of work is far from sufficient and the achievement far from ideal. Gaps and challenges have been identified, prospectively during the operations and retrospectively by after-action assessments.

A Ministry of Public Health (MOPH)-WHO joint review of Thailand's pandemic response conducted in September 2009 – the post-peak period of the first wave – revealed certain strengths in the risk communication system as well as certain weaknesses and significant challenges. Examples of major challenges are listed below:

- On planning: The plans did not fully meet their objectives and senior communication decision-makers were not fully engaged in emergency communication planning.
- On coordination: Not all key actors were involved in risk communication committees. Lack of synergy was evidenced in duplicating and overlapping efforts, and tools to ensure consistent messages (e.g. internal talking points and briefing notes for partners) were lacking.
- On listening: Data were not fully synthesized and made available for use by communicators.
- On media management: Often, basic risk communication principles were not applied; for instance, there were over-reassurances by health leaderships and frequent changes in the level of information provision. These practices, as well as conflicting messages from senior spokespersons and political overtones in emergency communication, led to suspicion and mistrust among media.

In addition, a number of useful recommendations were made in the joint review report, some of which are listed below:

- A media communication strategy for H1N1 vaccine should be developed that addresses issues of shortfall, prioritization and possible adverse events.
- Senior spokespersons should be trained on emergency risk communication.
- Communication committees should be restructured and streamlined to reduce duplication and overlap. Key internal and external partners should be included and assigned responsibility to ensure efficiency and strong leadership.
- Existing communication intelligence such as media monitoring, call-line questions, risk perception research and related information should be better utilized.
- Intelligence data should be gathered, analysed and distilled into a succinct report with key recommendations to guide communication decision-making.
- A short public communication message document (e.g. talking points) should be produced and updated regularly to guide spokespersons and partners in their own media interviews and communication activities.
- A policy or guideline on the public release of risk-related information should be developed and publicized to reassure citizens, media and stakeholders of the Government's commitment to transparency.

These findings and recommendations would be seriously considered by the MOPH and partners to improve preparedness planning for future pandemics as well as other public health emergencies.

Parallel Session 2

Noncommunicable diseases, risk factors and epidemiology

Chairpersons: *K Srinath Reddy*
Jerzy Leowski

Session Coordinator: *Jerzy Leowski*

From research to policy: example from NCD surveillance
– *Bela Shah & Prashant Mathur*

Reducing the burden of cardiovascular diseases in Asia – *Shah Ebrahim*

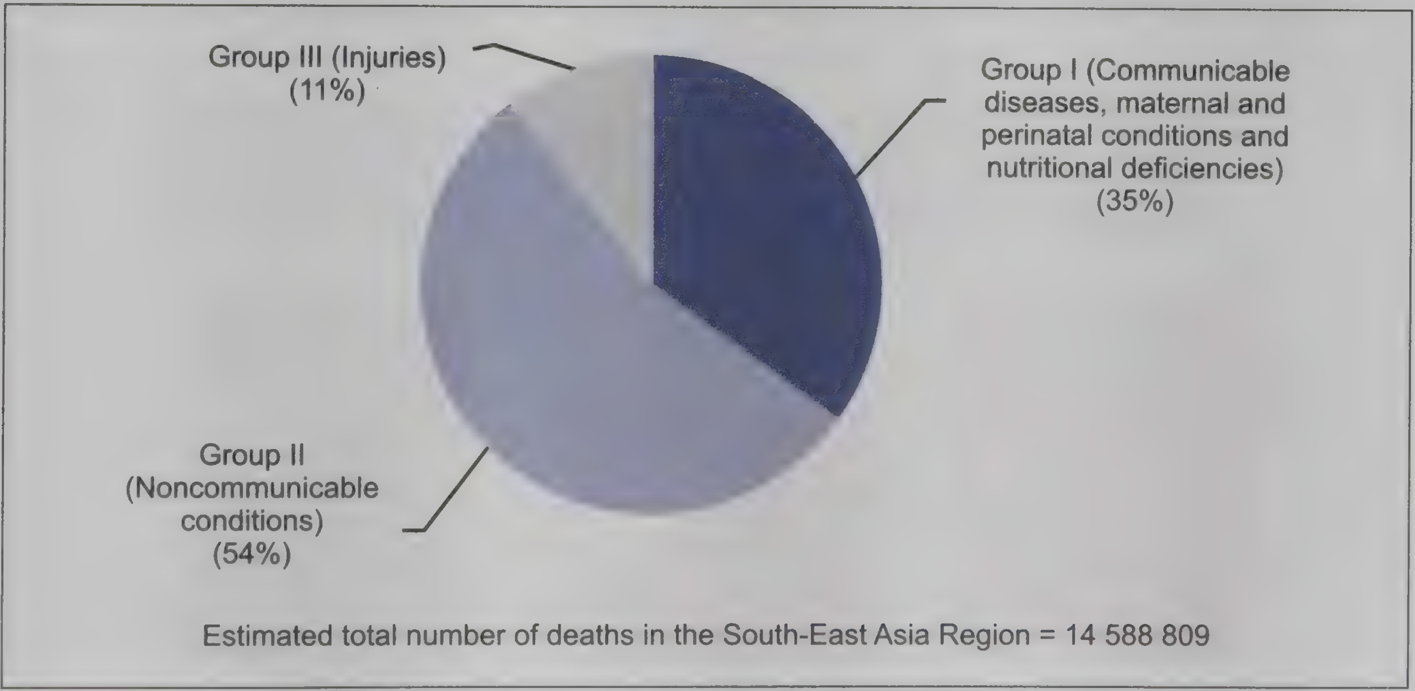
Research and evidence building for advocacy of noncommunicable diseases prevention and control programme
– *Rajesh Kumar and Dinesh Kumar*

From research to policy: examples from NCD surveillance

Bela Shah and Prashant Mathur

The health care needs of the world's population are undergoing dramatic changes due to demographic and disease transitions. Noncommunicable diseases (NCDs), such as heart disease, diabetes, cancer and depression, are rapidly replacing infectious diseases as the leading causes of adult disability and premature death. Eighty per cent of total deaths due to noncommunicable diseases occur in low-income countries. Men and women are equally affected. Cancer, cardiovascular diseases and diabetes are becoming serious concerns, accounting for 54% of deaths and 38% of the disease burden in countries in the WHO South-East Asia Region (WHO/SEAR). With the current trends, the top five causes of disability-adjusted life years (DALYs) lost in 2020 are likely to be ischaemic heart disease, unipolar major depression, road traffic injuries, cerebrovascular diseases, and chronic obstructive lung disease *(1)*. It has been estimated that a 2% annual reduction in deaths due to chronic diseases globally could result in preventing about 36 million premature deaths by 2015 *(2)*.

Fig. 1: Health situation in the WHO South-East Asia Region, 2001 - 2007



Source: WHO Geneva, Estimates of disease burden and deaths for 2005.

The State has a responsibility for promoting, maintaining and restoring optimal health of its population through well-defined public policies. There is enough reason to formulate policies based on scientific evidence in the context of their application. Choi has identified three areas and 12 essentials of developing a science-based policy *(3)*:

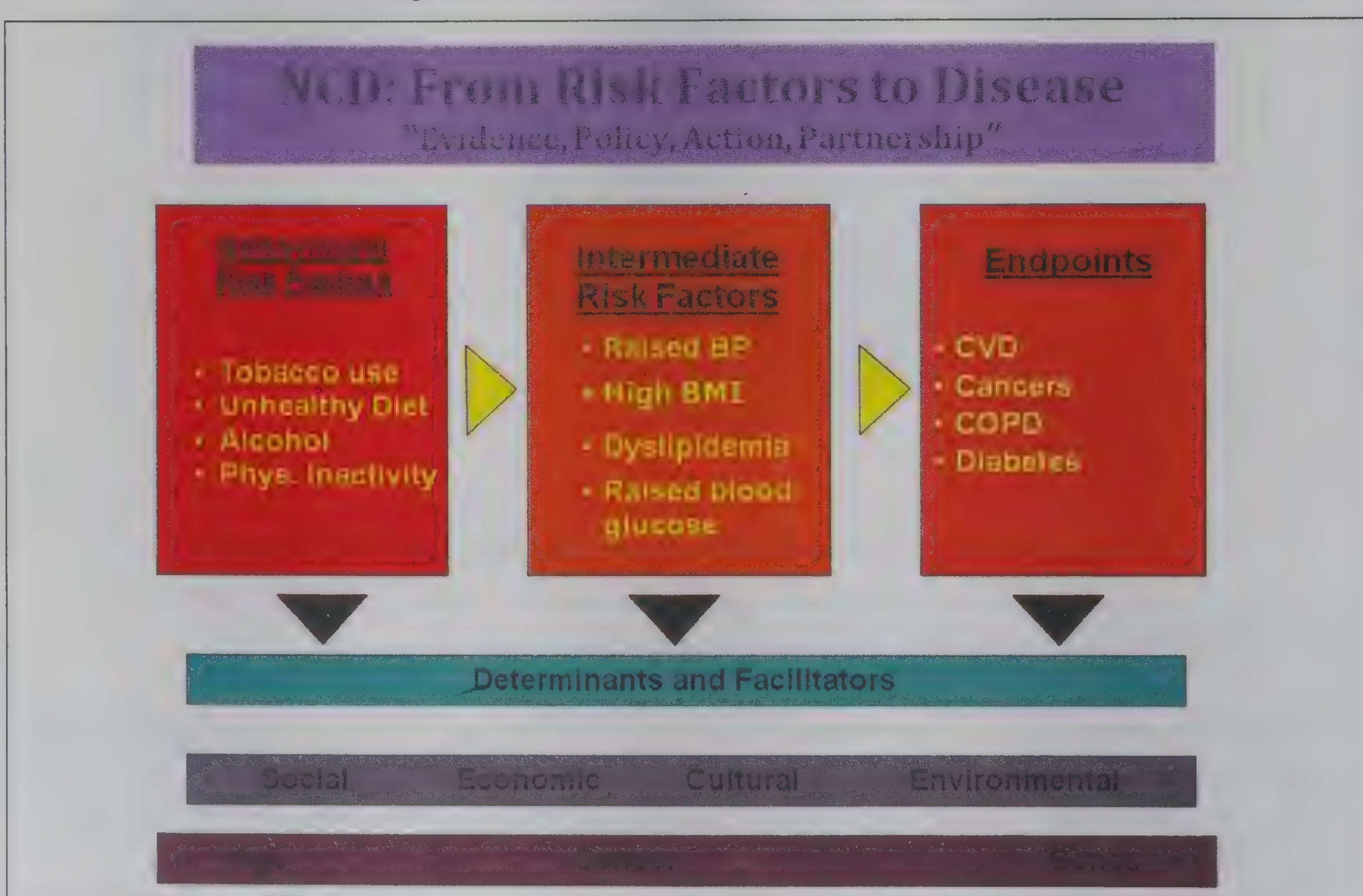
1. Knowledge generation - credible design, accurate data, sound analysis, comprehensive synthesis.
2. Knowledge exchange - relevant content, appropriate translation, timely dissemination, modulated release.
3. Knowledge uptake - accessible information, readable message, motivated user, rewarding outcome.

In this context, health policy-makers in several transition economies are faced with the burden of tackling the triple burden of disease in the complex scenario of competing health priorities, financial constraints, inconclusive evidence, contextualization of interventions and political commitments.

Research done using epidemiological tools generates analytical information on the magnitude, distribution, determinants, correlations, trends, projections of diseases and their risk factors and provides solution options for considering interventions. Public health surveillance is an ongoing process of systematic collection, analysis and interpretation of health data essential for planning, implementing and evaluating public health activities, closely integrated with timely dissemination of data, to enable effective and efficient action to be taken to prevent and control disease. It ranges from compulsorily notifiable diseases, specific disease registries (population-based and/or hospital-based), continuous or repeated surveys of representative samples of population to aggregate data for recording trends on consumption patterns and economic activity.

It would be ideal to do surveillance on noncommunicable diseases but this requires a lot of resources (human, financial, institutional) for its sustainability. It is now well established that a cluster of major risk factors (tobacco, alcohol, inappropriate diet, physical inactivity, obesity, hypertension, diabetes and dyslipidemias) govern the occurrence of major NCDs much before they are firmly established as diseases *(4)*. Collecting data on them and monitoring their trends is a good beginning towards disease surveillance since they are easily measurable and are amenable to interventions. Effective interventions would reduce the disease burden and promote health.

Fig. 2: Multi-level determinants of NCD risk factors



At the global level, WHO has formulated several policies based on evidence generated through research and surveillance such as The Global Action Plan for Prevention and Control of NCDs *(5)* and Global Strategy on Diet and Physical Activity for Health *(6)*. In the WHO South-East Asia Region, the Regional Framework for Prevention and Control of NCDs is driven by research and surveillance to support policy development, implementation and evaluation. Worldwide, public health surveillance systems have been developed and used for policy purposes,

The most significant contribution of research and surveillance has been the formulation of the WHO Framework Convention on Tobacco Control (FCTC) *(7)*. The treaty came into force in February 2005. It was signed by 168 of the 192 WHO Member States, and 156 countries have become party to the convention. It was developed in response to the global spread of the tobacco epidemic, which is facilitated by a variety of complex factors with cross-border effects, like trade liberalization and direct foreign investment. Other factors such as global marketing, transnational tobacco advertising, promotion and sponsorship and international movement of contraband and counterfeit cigarettes have also contributed to the exponential increase in tobacco use.

The Behavioural Risk Factor Surveillance System (BRFSS) was established in 1984 by the Centers for Disease Control and Prevention (CDC, Atlanta, USA) as a State-based system of health surveys that collects information on health-risk behaviours, preventive health practices and health-care access primarily related to chronic diseases and injury *(8)*. More than 350 000 adults are interviewed each year, making the BRFSS the largest telephonic health survey in the world. States use BRFSS data to identify emerging health problems, establish and track health objectives and develop and evaluate public health policies and programmes. Many states also use BRFSS data to support health-related legislative efforts. In 1990, the strategy was aligned to address the needs of the Healthy People 2000 Initiative, and later for the 2010 objectives. All BRFSS states prepare reports for dissemination and education of the public, health professionals and state legislators on prevailing health behaviour indicators.

The landmark efforts made under the North Karelia Project in Finland since 1972 have demonstrated the usefulness of risk-factor surveillance in evolving a public health response for the prevention and control of cardiovascular diseases (CVDs) *(9)*. Repeated surveys assessed the impact of the community intervention programmes for risk-factor reduction and thus helped in fine-tuning the policies. It demonstrated the benefits of developing linkages with important stakeholders.

The FINBALT Health Monitor is a collaborative system for monitoring health behaviours and related factors in Estonia, Finland, Latvia and Lithuania. It serves the public information, programme planning and evaluation needs of these countries. It also provides a data bank for researchers to work upon *(10)*. The WHO regional collaborations [Countrywide Integrated Noncommunicable Diseases Intervention Programme (CINDI), Conjunto de Acciones para Reduccion Multifactorial de Enfermedades Non Transmissible (CARMEN), South-East Asia Network for NCD Prevention and Control (SEANET-NCD), Eastern Mediterranean Approach to Noncommunicable Diseases (EMAN), Network of African Noncommunicable Diseases Interventions (NANDI) and Mobilization of Allies in Noncommunicable Diseases (MOANA)] aim at integrated prevention and control of NCDs and include risk-factor surveillance as a major component and link to policy.

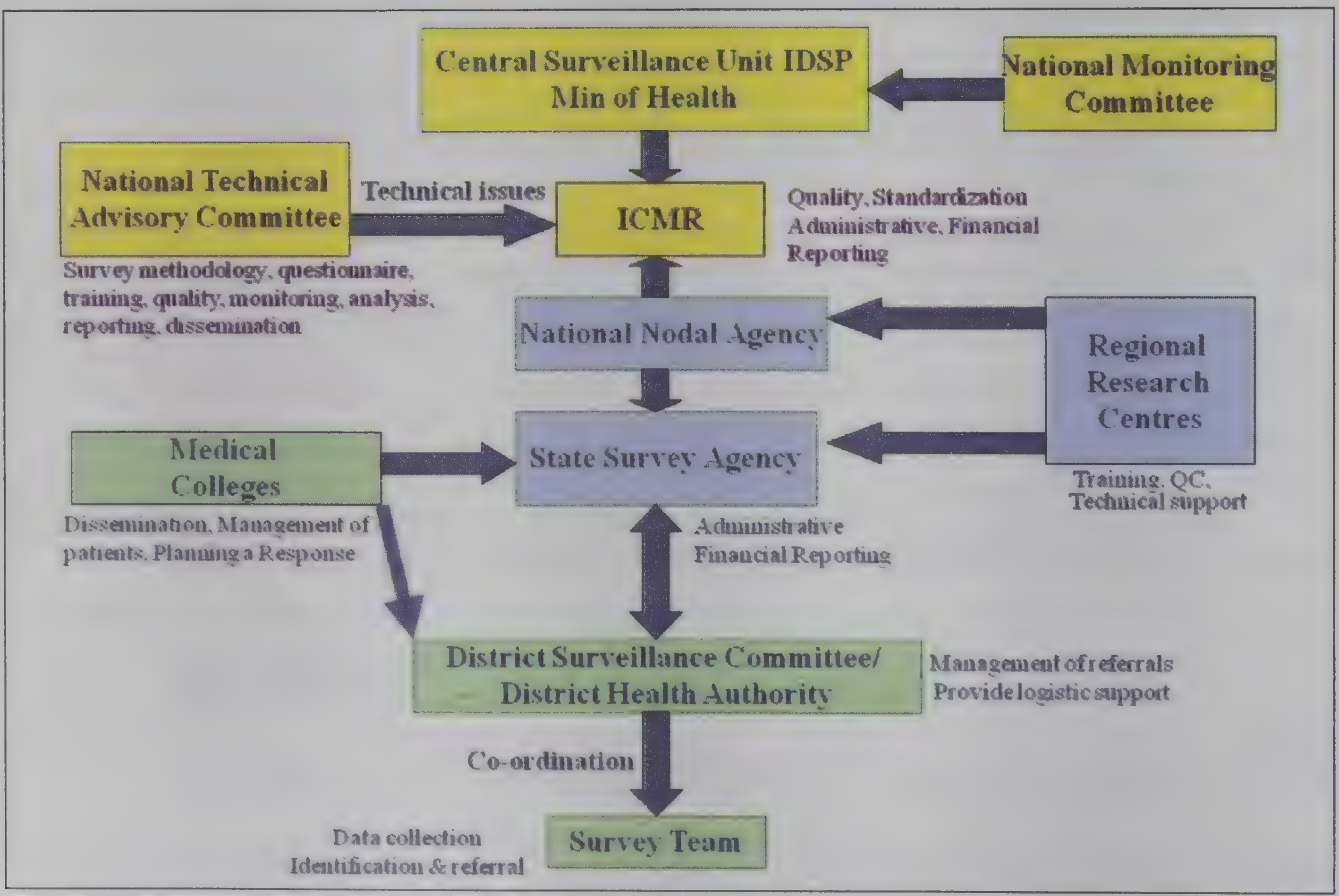
In addition, there are policies and partnerships around the world for increasing the consumption of fruits and vegetables, promoting physical activity, tackling the overweight and obesity epidemic and reducing salt consumption for hypertension prevention and control. Policy for the control of inappropriate alcohol consumption is being considered in some countries in view of its harmful public health consequences documented through research and surveillance.

In the WHO South-East Asia Region, there has been considerable progress in setting up NCD surveillance at national level in its 11 Member States. Since 2003, all countries have conducted at least one round of national-level NCD risk-factor survey using the standardized WHO STEPwise approach

to surveillance for NCD risk-factor surveillance and adapting it to local needs. Indonesia and Thailand have completed two national-level rounds of surveys. Countries have utilized the epidemiological information generated through these surveys as part of evidence to develop their NCD policy and have included surveillance of NCDs and their risk factors as its integral component. India and Indonesia have established an integrated NCD risk-factor surveillance system while some other countries are in the process of evolving similar systems.

The Indian Council of Medical Research (ICMR), in collaboration with WHO, conducted surveys on NCD risk factors adapting the WHO STEPwise approach at six sites across the country as a research initiative to assess the feasibility of setting up NCD risk-factor surveillance at national level. These surveys, conducted between 2004 and 2006, included behavioural, physical and biochemical risk factors for NCDs *(11)*. This initiative provided the requisite experience and mandate to respond to the World Bank-supported initiative of the Ministry of Health and Family Welfare, Government of India, to develop in 2007 a strategy for undertaking NCD risk-factor surveillance (consumption of tobacco, alcohol, fruits and vegetables, physical activity, waist circumference, body mass index and blood pressure) at the national level under the Integrated Disease Surveillance Programme (IDSP). These surveys were proposed to be carried out in 29 states/Union territories (UTs) in three phases. ICMR has been identified as the apex agency to plan and coordinate and provide quality assurance for these surveys. The programme has been structured at the national and state levels so as to make it integrated and sustainable. In the first phase, seven states were surveyed in 2007-08 through a well-laid-out network of implementation and monitoring at the national, regional and state levels. It utilized the framework of IDSP. The programme is monitored by a national technical advisory committee of ICMR and the National Monitoring Committee. In the proposed National Programme for Prevention and Control of Diabetes, Cardiovascular Diseases and Stroke, risk-factor surveillance would assist in monitoring the trends and assessing their impact.

Fig. 3: Organogram of noncommunicable diseases risk-factor surveillance under the Integrated Disease Surveillance Programme



India has only recently embarked on conducting NCD surveillance. Ongoing research and its inputs would greatly facilitate the collection and utilization of data to the maximum. The future of the surveillance system will lie in its validity, timeliness, systems approach and enduring partnerships. Consolidating the gains made should pave the path for the way forward.

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Reducing the burden of cardiovascular diseases in Asia

Shah Ebrahim

Cardiovascular diseases (CVDs) comprise heart attacks, strokes (ischaemic and haemorrhagic), peripheral vascular disease, hypertension and other less common conditions. Cardiovascular diseases are the major cause of death and disability globally but remain neglected *(1)*. Chronic-disease burdens have exceeded those of infectious diseases in the global death league since the first report of the global burden of disease project in 1990 *(2)*. There was no interest in making chronic diseases a target for the Millennium Development Goals (MDGs), and, subsequently in 2005, there was no evidence that chronic diseases had been prioritized under MDG 6 (which mentions "other diseases") *(3,4)*.

Disease burden and global health policy

The whole point of attempting to make estimates of the global burden of disease is to help policy-makers target resources where the need is the greatest. For the first time the massive contribution of chronic diseases to current and projected disease patterns in the developing world was made very clear and it threatened to change the balance of funding priorities *(5)*. One issue raised early on in the debate about what to do about the increasing burden of chronic diseases was that differential uptake of preventive strategies and curative health services would result in widening health inequalities. This question was tackled by the World Bank researchers who compared the most wealthy 20% with the least wealthy 20% globally and found that the poor-rich gap would increase if the focus shifted to prevention of chronic diseases (*6*). The paper concluded: *"Caution is needed before policy-makers embrace the current shift in emphasis from communicable diseases among the young toward noncommunicable disorders at older ages.*" There are two myths which need to be exposed: first, that the poor do not suffer from chronic diseases – that they are "diseases of affluence"; and second, that they are diseases of old age and do not affect the young. Srinath Reddy, now president of the Public Health Foundation of India, was one of the few critical commentators at the time, highlighting the importance of chronic diseases to the health of the poor *(7)*. A recent analysis on the prevention of cardiovascular diseases concludes that there is no increase in health inequalities *(8)*.

The launch of the Millennium Development Goals in 2000 has achieved much in many countries, although anxieties are now rising with concerns that targets are being missed, with trends even going in the wrong direction and that the MDG focus has pushed out other 'deserving' areas such as acute pneumonia and diarrhoea which are bigger killers of children than the diseases covered by MDGs. There is little doubt that they have contributed to the continued neglect of the chronic disease agenda and dominated health policy in developing countries in the face of compelling evidence of changing disease patterns. Perhaps, surprisingly, after a decade, the World Bank has reversed its position and has published a major contribution on the evidence relevant to the prevention and control of chronic diseases *(9)*.

The need for better burden-of-disease data

Counting the burden of disease in many countries in South Asia is difficult owing to several limitations in: health information systems, surveillance for chronic diseases, coverage of vital registration systems and attribution of cause of death. Efforts to understand the disability associated with chronic diseases in the region are also hampered by a lack of information from local studies. Given these circumstances, global burden of disease statistics must be taken with some caution, but they indicate the growing dominance of noncommunicable diseases and, of these, cardiovascular disease is among the most common cause of death and disability in the region.

Rank	Disease	DALYs (millions)	Percent of DALYs
1	Lower respiratory infections	28.3	6.4
2	Diarrhoeal diseases	23.0	5.2
3	Ischaemic heart disease	21.6	4.9
4	Unipolar depressive disorders	21.1	4.8
5	Prematurity and low birth weight	18.3	4.1
6	Neonatal infections and others	14.3	3.2
7	Birth asphyxia and birth trauma	13.9	3.1
8	Tuberculosis	12.4	2.8
9	Road traffic accidents	11.0	2.5
10	Cerebrovascular disease	9.6	2.2

South-East Asia Region, WHO: Global Burden of Disease, 2004

However, new approaches to collecting valid data are available. For example, the million-deaths study links data from the sample registration surveys conducted in India to estimate population dynamics to deaths that are ascertained by interviewers who then conduct verbal autopsies to ascertain the cause of death *(10)*. Reassuringly, these direct estimates of the cause of death tally with the indirect estimation methods used in the Global Burden of Disease study. An increasing number of demographic surveillance sites (DSS) in developing countries are involved in a data-sharing project with International Health Metrics and are collecting verbal autopsy data, which will further improve the quality of burden-of-disease estimation.

Global and regional projections suggest that an increasing share of the burden of disease will be attributed to cardiovascular disease. We know from Western experience that ischaemic heart disease and stroke show dramatic trends over time, with great increases, particularly among men, peaking in the 1970s and '80s, followed by steep falls in the 1990s *(11)*. The underlying reasons for these trends are changes in the common CVD risk factors (smoking, blood pressure and blood cholesterol) *(12)*. Improvements in prevention and treatment may have had a significant impact on the falls seen in most Western countries *(13)*.

Reducing the burden

WHO, in 2005, set a global goal of reducing chronic diseases by 2% every year between 2005-2015 *(14,15)*. Setting this target does not seem to have enthused public health movements, perhaps because the surveillance systems to monitor any progress do not exist in most developing countries. Trends in CVD incidence, where data are available, indicate rising, rather than falling, rates in low- and middle-income countries. Establishing robust surveillance systems is a high priority in developing a CVD prevention and control strategy.

The rationale for focusing on the prevention and control of cardiovascular diseases are: a) the burden is rising in low- and middle-income countries; b) they affect people at the peak of their productive lives; c) an integrated health system is required for all health needs, not for specific diseases; d) there are cost-effective interventions available that, if implemented, would save lives, reduce suffering and poverty; and e) reducing CVD risk factors will reduce deaths due to infectious diseases *(16,17,18,19)*.

In following up their 2005 initiative, WHO published a further set of articles in *Lancet* in 2007 to present a strategy for the prevention and control of chronic diseases, with a strong focus on CVDs. These articles updated the burden estimates, including economic burdens *(20)*, providing cost-effectiveness estimates for both population *(21)* and high-risk individual treatments *(22)*. A call to action was mounted claiming that "*36 million deaths from chronic diseases could be postponed by public health and primary care in the next 10 years at a cost of US$1.50 per person per year" (23)*.

Calls to action on specific interventions

Tobacco: Full implementation of the WHO Framework Convention on Tobacco Control (FCTC) *(24)* is an essential component of reducing the CVD burden. Action on smoking and health is variable in the region and little attention has been given to the issue of taxation levels on *bidis (25)* or tobacco crop substitution programmes. In Pakistan, these hand-rolled cigarettes are among the cheapest in the world (US$0.25 for a packet of 10 cigarettes) and are widely exported.

Salt: A second strategy promoted by WHO and others is reduction in dietary salt intake with estimates of profound reductions in high blood pressure, stroke and ischaemic heart disease (*21*). However, empirical evidence on the ability of people to reduce their salt intake long term is not encouraging *(26)*. Voluntary restrictions on hidden salt by food manufacturers is also being promoted, but it remains rather difficult in this region as the market is dominated by very large numbers of small, non-regulated producers. Estimates of the costs of tobacco and salt restriction policies appear affordable.

Drugs: A combination of effective drugs is proposed - comprising aspirin, a statin and two blood pressure-lowering drugs (*22*). This combination approach scores highly in reducing deaths and events and has a low average cost of US$1 per person per year. Such drugs are now being evaluated in large-scale trials and should offer real benefits if coverage and adherence can be assured.

However, there are considerable uncertainties in implementing these prevention packages through "calls to action" which have been discussed *(27,28,29)*.

Are they really affordable? Reallocation of health budgets is rather difficult to achieve in countries that are spending only 1%-3% of their gross national income on public health services. There is seldom any space for new spending with resources fully committed to existing programmes.

Is it clinically relevant? Doctors and nurses in developing countries are already overwhelmed with acute clinical problems. How to re-orientate their practice to changing disease patterns? The training and reorientation of all levels of the health system workforce to respond to changing demography and epidemiology is essential but has not yet been implemented.

We're all going to die! The debate about CVD prevention has not taken notice of the fact that competing causes of morbidity and mortality and co-morbidities will increase markedly when a greater proportion of the population survives to older ages. Preventing a CVD death at age 50 may result in survival to 70 but with complications and increased health care costs. Modelling the life-course trajectories of prevention strategies will be an important means of providing evidence on relevance (or otherwise) of this issue.

Is the message clear? Science is nuanced in its language and avoids over-strong conclusions from less-than-robust data. Advocacy requires a clear, simple and consistent message, and with the exception of much of the tobacco control messages, simplification of the message hides the subtlety. Existing attempts – for example, Oxford Health Alliance's "3four50" campaign is opaque to a naïve reader and is difficult for an informed but ageing advocate for chronic disease to remember. It means that three risk factors (tobacco, unhealthy diet and physical inactivity) cause four diseases (cardiovascular disease, type 2 diabetes, lung disease and many cancers) which cause 50% of the deaths in the world (www.3four50.com). Nice try but it is not as catchy as "No health without mental health", which is the headline for the Movement for Global Mental Health (www.globalmentalhealth.org).

It's the health system that is important! We should be seeking means of strengthening existing health care systems in their ability to provide comprehensive, accessible, community-based and family health care – preventive, curative and rehabilitative – for both communicable and noncommunicable diseases. This will involve re-integration of current vertical programmes (e.g. for malaria, polio, TB, HIV) into novel forms of family-orientated primary care *(30,31)*.

A parallel agenda for CVD prevention and control

Existing proposals aim to deal with the distribution of risk factors by reducing exposure to tobacco and unhealthy diets through fiscal and legislative measures, individual behavioural change and pharmacological treatments. But such approaches miss the crucial link between the risk factors and their primordial – upstream - determinants of health *(32,33)*. These include poverty, illiteracy, injustices, poor governance of public and private systems and corruption, which are potent reasons underlying the reasons why achieving MDGs in many countries is so difficult *(34)*. System failures result in downgrading of the effectiveness of interventions recommended for CVD: failures of full coverage, accurate diagnosis, compliance with guidelines by professionals and adherence to health behaviours and medications by patients are rooted in poverty, illiteracy, injustices, poor governance and corruption *(35)*. A new set of strategies using a political process approach is under active discussion *(36)*.

The Commission on Social Determinants of Health (CSDH) *(37)* has demonstrated that people have limited choices and control over their lifestyles and that these are determined in large part by the circumstances in which they live. There is a growing realization among global health funders and policy-makers that chronic diseases are a consequence of upstream drivers of ill health and, in turn, chronic diseases adversely affect human development goals. Tangible recognition of these relationships is occurring with the 2009 Global Risks report of the World Economic Forum's rating of chronic diseases as more important to economic security than the global financial collapse *(38)*.

Conclusion

Chronic diseases are common causes of death, disability and misery affecting millions of people in developing countries. These diseases are caused by upstream determinants - poverty, illiteracy, injustices, inadequate governance, insurgency and corruption – which influence the ability of many countries to meet MDGs and do anything about chronic diseases. Focusing on the upstream determinants re-orientates chronic diseases agenda as a central part of the development agenda. There is much that can be done about the downstream determinants of chronic diseases, in particular, control of risk factors - tobacco, nutrition, physical activity, high blood pressure, high blood glucose – through fiscal, legal, behavioural and pharmacological interventions. However, a strong focus on the upstream determinants and re-engineering of the health system (with integration of vertical programmes) will be required to make progress in reducing the burden of chronic disease and its impact on human development.

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Research and evidence-building for advocacy of noncommunicable diseases prevention and control programmes

Rajesh Kumar and Dinesh Kumar

Advocacy is the pursuit of influencing outcomes which include public policy and resource allocation decisions within political, economic and social systems and institutions that directly affect people's current lives *(1)*. Successful advocacy defines target audience, finds out the facts and messages and mobilizes others. Advocacy aims to apply the best available evidence gained from scientific research to decision- making. It includes a wide range of activities with the common goal of improving people's health.

In public health, evidence is generated in terms of disease epidemiology and effective interventions. International organizations like the World Health Organization (WHO) and national research bodies assist in generating evidence. In addition, government and private academic institutions also carry out research. Guidelines to carry out valid research are drafted by international and national research organizations. Research done at local level by individuals or groups is published in science journals which are a common source of evidence for the rest of the world. Evidence-building also includes assessment of the quality of evidence collected. Systematic reviews of available research literature provide answers to relevant research questions and advance the knowledge base. Synthesis of existing knowledge and advocating its use are important strategies in public health.

Evidence-based health care is the scientific use of currently available best evidence in making decisions about patient care or delivery of health services. Current best evidence is the latest available information based on relevant and valid research about the effects of different forms of health care, the potential for harm from exposure, the accuracy of diagnostic tests and the predictive power of prognostic factors *(2)*. Evidence-based clinical practice is an approach to decision-making in which the clinician or public health manager uses the best available evidence and decides the best option available for health care *(3)*. Evidence-based medicine is the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence-based medicine means integrating individual clinical expertise with the best available external clinical evidence derived from systematic research *(4)*.

Advocacy takes current best research to policy-makers as they direct social change by planning policy and spending. Knowledge is the cornerstone of advocacy. There must be a powerful argument to build a persuasive case. The knowledge should be valid, should reflect the severity of a problem and propose a solution, and be relevant and localized for the audience.

Knowledge of a local problem and data thereon are more powerful for advocacy than information gathered globally. Data on a local problem has far more significance. A survey on the causes of death in India *(5)* found that noncommunicable diseases (NCDs) contributed to around 42.4% of total deaths – 45.0% in males and 39.1% in females. A further analysis showed that NCDs caused 55.0% deaths in urban and 39.7% in rural communities. Policy-makers thus would like to have local

evidence on the disease burden. A disease priorities report shows that cardiovascular diseases in low- and middle-income countries cause about 13 million deaths each year, which is over a quarter of all deaths in these countries. Most cardiovascular deaths result from ischaemic heart disease (5.7 million) or cerebrovascular disease (4.6 million). Increasing tobacco use accounts for a substantial but avoidable number of deaths from cardiovascular diseases and cancers. Reducing smoking levels is well demonstrated to be within the control of public policy.

Interventions aimed at changing diet and lifestyles include educating individuals, changing the environment, modifying food supply, undertaking community interventions and implementing economic policies. In some countries, policy-level changes have been introduced for the prevention and control of NCDs. For example, school-based physical education to promote physical activity among young people in China increased their activity levels; 72% of children aged 6 to 18 years carried out moderate to vigorous physical activity for a median of 90 to 100 minutes per week.

A national policy can limit the use of automobiles to increase physical activity. Singapore introduced a vehicle quota and road-pricing system to limit vehicle ownership. Walking or cycling are effective and practical means of engaging in physical activity and are still the most common mode of travel in many developing countries. Evidence from Chennai (India), Manila (Philippines) and Bangkok (Thailand) indicate a majority of people either walk or use public transport *(6)*.

Healthy food choices is also an important public health intervention. Improved methods of food processing, fortification and manufacturing, increased availability of healthy foods and limiting aggressive marketing of unhealthy foods are policy-level issues for the prevention and control of chronic diseases. Community-level interventions such as the comprehensive intervention approach implemented in South Africa are useful. There, a partnership between an insurance company and an academic institution had created programmes targeted at specific age groups that included children and older adults. The twice-weekly classes reduced blood pressure and increased strength and balance *(7)*. The Singapore National Healthy Lifestyle Programme uses a multidisciplinary approach to increase physical activity and healthy diets among schoolchildren, due to which, between 1992 and 2000, the rate of obesity among children declined *(8)*. In Iran, the Isfahan Healthy Heart Programme for research and training for cardiovascular diseases control, prevention and rehabilitation for cardiac patients has developed a comprehensive, integrated community intervention involving schools, worksites, health care facilities, food services, urban planners and the media. Physical activity was promoted by creating safe routes for walking and bicycle riding and by organizing recreational walking that involved entire families *(9)*.

Successful intervention in China such as the Tianjin Project showed a significant reduction in sodium intake in men and reduction in hypertension and obesity *(10)*. In Mauritius, government-led initiatives resulted in changing the composition of cooking oil from high saturated fatty acid palm oil to unsaturated acid soya bean oil. It resulted in a significant fall in the cholesterol levels of the population *(11)*.

Knowledge generated from research is meant to be transmitted as a message to policy-makers. The message should be simple and objective, based on strong statistically-supported facts. The facts need to be freshly collected, containing latest trends and developments. Arguments based on similar studies conducted elsewhere increase the credibility of information. Identifying the level of government to be approached is an important step in advocating policy change. Meetings with government ministers to motivate them for policy change are very useful.

Drawing together different population-wide interventions in different countries produces a synergistic effect *(12,13)*. Reviews of different strategies in various countries with different methods and interventions lead to development of a common theme. Evidences across the world like the National Heart, Lung, and Blood Institute (NHLBI) Obesity Education Initiative *(14)* and the National Cholesterol Education Programme (NCEP) *(15)* Expert Panel demonstrated the effectiveness of

lifestyle and dietary interventions. The Framework Convention on Tobacco Control (FCTC) acted as an important advocacy agency to reduce tobacco smoking worldwide. It consisted of a series of negotiated protocols within a general framework. The protocols cover negotiations in smuggling, advertising and treatment of tobacco addiction. Most countries who agreed to the negotiated protocols have adopted or are in the process of adopting appropriate legislations and taking necessary implementing measures.

Implementation of the recommended policies to promote health and well-being is often not a straightforward issue because of opposition by powerful and well-funded political and economic forces, such as those involved in the tobacco, automobile, food and oil industries *(16)*. The solution depends on the political structure of a country and the will of its leaders. However, experiences in many countries have shown that the coming together of public interest groups, professional organizations and motivated individuals has resulted in effective advocacy when it was supported by scientific data, mass media, lobbying efforts and, at times, public lawsuits.

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Parallel Session 3

Re-focusing on forgotten priorities: acute diarrhoea and pneumonia

Chairpersons: *N.K. Arora*
Richard Cash

Session Coordinator: *Madhu Ghimire*

The role of current diarrhoea management in decreasing child mortality – *Yati Soenarto*

The burden of Pneumonia in the WHO South-East asia Region – *Shams El Arifeen*

Integrating prevention and control of acute diarrhoea and respiratory infections in the WHO South-East Asia Region: a new initiative – *Madhu Ghimire*

The role of current diarrhoea management in decreasing child mortality

Yati Soenarto

Millennium Development Goals (MDGs) represents international paradigm of global development agreed by 189 member states of the United Nations (UN) at the Millennium Summit in September 2000. The purpose is to reduce poverty and its impacts, such as hunger, disease, low education level, gender gap, and environment problem, by 2015. Each goal has one or several target including indicators to measure progress. Among the eight goals, the focus of MDG 4 is reducing infant mortality rate. Its target is to reduce mortality rate of children less than five years of age (U5) by two thirds in 1990-2015 with following indicators: 1) infant mortality rate per 1,000 live births, 2) child mortality rate per 1,000 live births, and 3) percentage of children aged between 12-23 months immunized against measles.

Indonesia has made progress by reducing infant mortality rate from 68 per 1,000 live births in 1991 to 32 per 1,000 live births in 2005. As for U5 children, the mortality rate has decreased from 97 per 1,000 live births in 1991 to 40 per 1,000 live births in 2005. The percentage of children aged 12-23 months received measles immunization was increasing from 57% (1990) to 71.6 % in 2003.

All efforts, such as, promotion of the use of insecticide-treated mosquito net, oral rehydration for diarrhoea, increased access to vaccine for various infectious diseases, and increased water quality and sanitation have made significant contribution to this improvement. Despite overall reduction in infant and child mortality rate, mortality caused by preventable disease remains high and higher compared to other ASEAN countries: 4.6 times more than Malaysia, 1.8 times more than Thailand, and 1.3 times more than Philippines.

Pneumonia and diarrhoea are still the main cause of under five children mortality worldwide. In Indonesia, the number of deaths caused by diarrhoea has exceeded the number caused by pneumonia.

Current diarrhoea management

WHO and UNICEF have recommended policies for health professionals on treatment of diarrhoea, which are: 1) Counsel mother to begin administering suitable home fluids immediately upon onset of diarrhoea in a child, 2) Treat dehydration with new low osmolarity ORS (or with intravenous electrolyte solution in cases of severe dehydration), 3) Emphasize continued feeding or increased breastfeeding during, and increases feeding after the diarrhoea episode, 4) Use antibiotics only when appropriate, i.e., in the presence of bloody diarrhoea or shigellosis, and abstain from administering anti-diarrhoea drugs, 5) Provide children with 20 mg per day of zinc supplementation for 10-14 days (10 mg per day for infants under six months old), and 6) Advise mothers of the need to increase fluids and continue feeding during future diarrhoea episodes.

New findings in management of diarrhoea have created a program called "Lintas Diare", abbreviation of "Lima Langkah Tuntaskan Diare" (in English means "Five Steps to Eradicate Diarrhoea"). This program is adapted from WHO Treatment Plan which is further developed by Indonesian Ministry of Health. The diarrhoea management consists of: 1) Use of new ORS (low osmolarity); 2) Zinc supplementation for 10 days; 3) Continuation of breastfeeding and food intake (depends on age); 4) Selective use of antibiotics with indication, as in dysentery and cholera; and 5) Mother counseling.

Evidence-based new management of diarrhoea

Low osmolarity ORS

The discovery of oral rehydration salts (ORS) solution is considered to be one of the greatest achievements of medical research in the 20th century. During the past 30 years, numerous studies have been undertaken to develop an "improved" ORS, which is optimally safe and effective for treating or preventing dehydration in all types of diarrhoea, and would also cause reduced stool output or have other clinical benefits when compared with standard ORS. Although standard ORS have been well documented in dramatically decreasing the mortality rate due to dehydration in children with diarrhoea, many efforts were still carried out to find new formulation which could be more effective but safer. This new formulation must be better in improving clinical condition compared to standard ORS.

Standard ORS were previously prepared for choleriform diarrhoea, with higher lost in sodium compared to non-choleriform diarrhoea. Therefore, standard ORS (Na 50-75 mEq/L, osmolarity 245 mOsmol/L) will bring risk of hypernatremia and hypertonicity diarrhoea if given for non-choleriform diarrhoea. Further studies then attempted to find new formulation with lower level of sodium resulted in lower osmolarity, with the ratio sodium: glucose is 1:1 in order to decrease the risk of hypernatremia.

Many studies have been conducted to determine the efficacy of new formulation of ORS. In several meta-analyses, it is proved to decrease the need of intravenous rehydration, volume of stool, frequency of vomiting, as well as the risk of hypernatremia. Based on these findings, in May 2002, WHO recommended new formula ORS to be used for diarrhoea children, and monitor its safety especially for the risk of symptomatic hyponatremia. In developing countries like Indonesia, the limited supply of ORS had promoted many efforts to use home-based fluid as an alternative for managing diarrhoea. Studies had shown that home-based fluid, such as soup, rice-based ORS, and sucrose electrolyte solution can be used to treat diarrhoea children, and this has been one example of local wisdom from Indonesia.

Zinc supplementation

Deficiency of zinc has been known to impair sodium and water absorption of gut, therefore the development of zinc tablet has brought great potential in the management of diarrhoea. Several meta-analyses had found the effect of zinc supplementation in decreasing frequency of defecation, decrease the duration of acute diarrhoea, as well as decrease the risk of diarrhoea. Furthermore, zinc also has a role in improving cellular and humoral immune system, and has the effect of anti diarrhoea through blockage of chloride secretion. WHO recommends zinc supplementation in the management of diarrhoea for minimum of 10 days (10-14 days) as much as 20 mg/day for children aged more than 6 month, and 10 mg/day for children aged less than 6 months?

Global child deaths due to rotavirus

WHO and GAVI alliance has recommended that regional surveillance networks be established to collect local disease and economic burden of rotavirus to help the introduction of new rotavirus vaccine into developing countries. In 1999, the CDC, WHO, and industry partners arranged a workshop to establish ARSN. Nine countries and regions participated in the 1st phase of ARSN, during 2001-2003. In 2004, data was collected for the 2nd phase, including a greater proportion of poorer countries. Indonesia was represented by a rotavirus team from Universitas Gadjah Mada (UGM). Using WHO generic protocols for hospital based surveillance to estimate the burden of rotavirus gastroenteritis in children, from the year of 2000 to 2004, this team conducted hospital surveillance in 3 hospital sites, located in 2 provinces. Those hospitals were located in Jogjakarta province: one is a provincial teaching hospital, whereas the other one is a regency hospital. Another one provincial hospital was located in Jogjakarta Province. Rotavirus positive was identified in 54% of all children less than 3 year of age admitted for gastroenteritis. First rotavirus surveillance was conducted in this teaching hospital in 1977-1978; with 38% of children with acute diarrhoea were rotavirus positive. This team established Indonesian Rotavirus Network Surveillance (IRSN), as a member of ARSN.

The 2nd surveillance was conducted in 2006 – 2007, involving 6 province teaching hospitals in Indonesia, which were Jogjakarta as the center for IRSN. Those sites are Palembang, Jakarta, Bandung, Bali, and Mataram. The 4th surveillance in 2009 was involving 4 areas, which were Yogyakarta, Bandung, Bali, and Mataram.

Two commercial Rotavirus Vaccines have been successfully developed and will be widely spread, but the high cost of these vaccine is still a big constrain in developing countries, where the disease burden is greatest. RV3 Rotavirus Vaccine has the potential to make a major impact on the health of children in Indonesia, Australia and the developing world, as it is low cost, orally administered and suitable for neonatal immunisation. It originates from neonatal strain of rotavirus in Australia.

Universitas Gadjah Mada has established long term and sustainable collaboration with Murdoch Children's Research Institute (MCRI) and Royal Children's Hospital Melbourne. MCRI, Royal Children's Hospital Melbourne, Australia, Biofarma Bandung, and UGM team effort to develop RV3 Rotavirus vaccine which will be produced in Indonesia, as one of the developing countries producing rotavirus vaccine.

In conclusion, it could be accepted that current diarrhoea management decreases child mortality from several new findings supported by strong evidences as following: 1) following treatment with reduced osmolarity ORS & rice-based ORS significantly lower the mean of diarrhoeal duration in acute diarrhoea compared to Standard ORS. This new ORS solution was also associated with 33% reduction in the need for unscheduled IV therapy. 2) Zinc reduces the duration and severity of acute diarrhoea, whereas breast feeding shortens the duration of acute diarrhoea, rotaviral diarrhoea, and persistent diarrhoea. Early breast feeding (within the first 3 days of life) reduces the risk of diarrhoea in the first 6 months of life due to the effects of human colostrums.

The burden of pneumonia in the WHO South-East Asia Region

Shams El Arifeen

Pneumonia is a major health challenge for programme managers and researchers in the South-East Asia Region of WHO. Of the 155 million pneumonia cases that occur every year in the world, about 60 million (39%) are in this Region; India, Bangladesh and Myanmar account for a substantial number of these cases. The incidence of pneumonia is also the highest in this Region (0.36 episodes per child year) (Table). In a poor urban area of Dhaka, Bangladesh, the incidence is even higher - about 0.51 episodes per child year. As a cause of death among the under-five children, pneumonia leads with 19%, followed closely by diarrhoea (18%). India and Bangladesh together account for one fourth of the two million deaths from pneumonia globally, which is a major share of child death burden from pneumonia.

Table: Estimates of incidence and number of new cases per year of clinical pneumonia in children aged less than 5 years, by WHO region[a]

WHO region	Total population Aged 0-4 years (millions)	Estimated incidence (e/cy)	Estimated no. of new cases per year (millions)
African	105.62	0.33	35.13
Americas	75.78	0.10	7.84
Eastern Mediterranean	69.77	0.28	19.67
European	51.96	0.06	3.03
South-East Asia	168.74	0.36	60.95
Western Pacific	133.05	0.22	29.07
Total (developing countries)	523.31	0.29	151.76
Total (developed countries)	81.61	0.05	4.08
Total	604.93	0.26	155.84

e/cy: episodes per child-year

[a] Up to 10% of all new cases may profress to severe episodes and require hospitalization.

Source: Rudan I, Boschi-Pinto C, Biloglav Z, Mulholland K, Campbell H. Epidemiology and etiology of childhood pneumonia. Bull WHO, 2008; 86: 321-416.

The aetiology of pneumonia is quite varied. Available data suggest that pneumococcus is a significant cause of pneumonia in children (30% to 50%), followed by *Haemophilus influenzae* type b (Hib) (10% to 30%) and *Staphylococcus aureus*. Among viruses, respiratory syncytial virus (RSV) has been associated with 15% to 40% of childhood pneumonia or bronchitis, with recent evidence indicating that influenza viruses are emerging as major contributors. Recent data from urban Dhaka show that about 28% of influenza-positive cases in children eventually develop into pneumonia.

The risk factors for childhood pneumonia fall into three categories. These are (a) definite risk factors: malnutrition and low birth weight, non-exclusive breastfeeding, lack of measles immunization, indoor air pollution and crowding; (b) likely risk factors: parental smoking, nutritional zinc deficiencies, mother's inexperience as a caregiver and other concomitant diseases such as diarrhoea; and (c) possible risk factors, which commonly underlie many of the cases: mother's education or lack of it, daycare, rainfall (humidity), high altitude (cold air), vitamin A deficiency, birth disorder and outdoor air pollution.

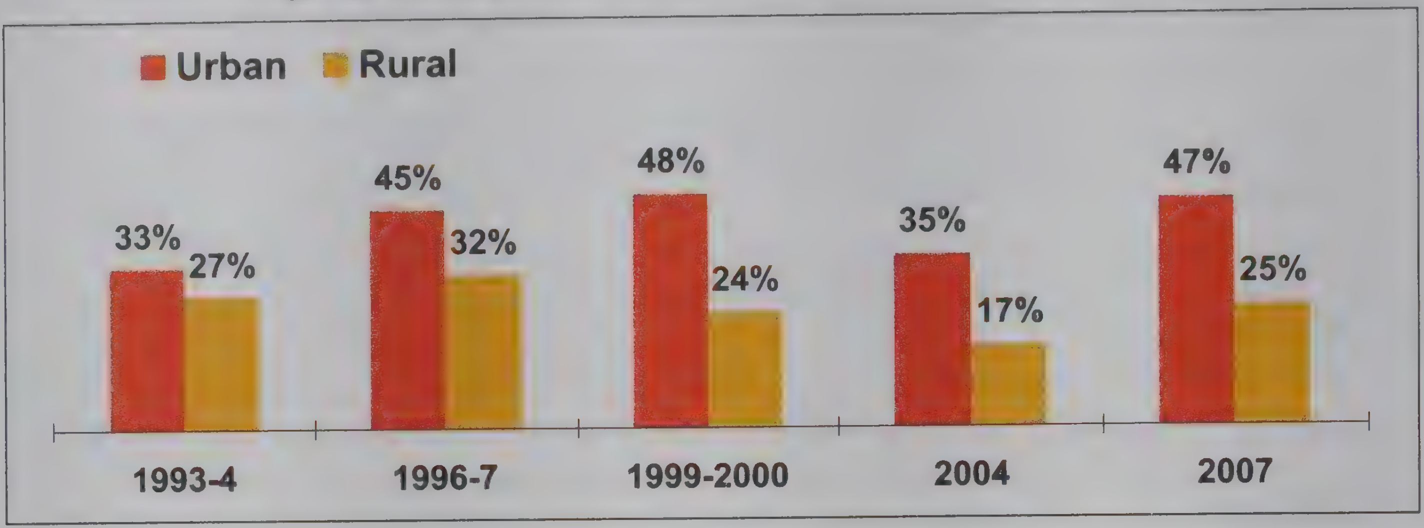
Some of the pneumonia risk factors are generally high in the countries in the Region, e.g. low birth weight and stunting. The incidence of low birth weight is very high in Bangladesh, India, Maldives, Nepal and Sri Lanka. Only Indonesia and Thailand report low levels of low birth weight. Stunting is also very common in Bangladesh, India and Nepal. Sanitation facilities are not adequate except in Sri Lanka and Thailand. Immunization coverage is high in most countries with the exception of India. The rates of exclusive breastfeeding in children aged less than six months are not high in any of the countries in the Region, except DPR Korea.

In general, there is a scarcity of pneumonia treatment coverage data in the Region. The proportion of children with pneumonia taken to an appropriate health-care provider ranges from as low as 22% in Maldives to as high as 93% in DPR Korea. The coverage is 30% in Bangladesh, 60% in India and 84% in Thailand. There is much less data available on the key treatment intervention, i.e. whether or not a child with pneumonia received antibiotics. There is no national monitoring of this indicator, in contrast to the routine data collection and reporting on children with diarrhoea receiving oral rehydration solution (ORS).

Bangladesh provides an interesting case-study on interventions that are important in preventing and treating pneumonia and diarrhoea. It is one of the few countries with a fairly high rate of ORS use. The data from the last five Demographic and Health Surveys (DHS) show an increased use of ORS. In the last survey in 2007, about 81% cases reported using ORS for diarrhoea in the previous two weeks, and the rate was similar in both urban and rural areas. This possibly partly explains the large decline seen in the deaths due to diarrhoea in the country. There is anecdotal evidence from ongoing research to suggest that the incidence of diarrhoea may also be going down in the country. In contrast, the pneumonia treatment rate and mortality (as proportion) has remained static over these years. An explanation for this is that the risk factors, behaviours and practices associated with pneumonia have not changed much over the years. There has been no change in exclusive breastfeeding rates in Bangladesh. The last DHS survey showed a slight improvement in the early ages but no overall improvement in exclusive breastfeeding rates. Improvement in the nutritional status has been quite small; stunting has declined 16% between 2004 and 2007. However, there are large differentials in stunting by economic conditions, with the poorest having more than twice the burden of stunting than the least poor.

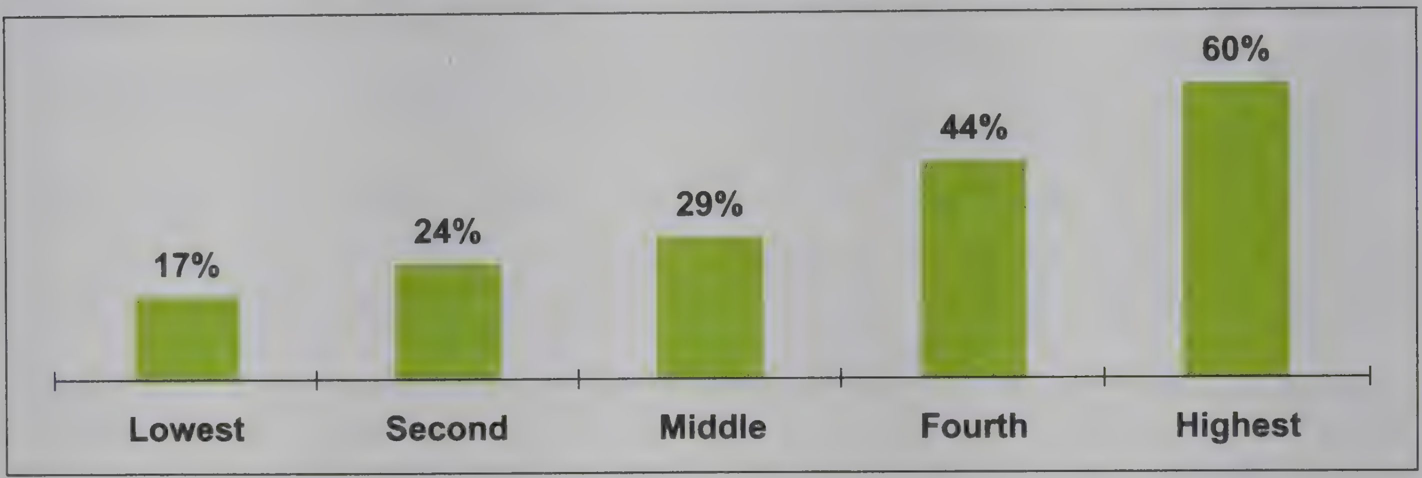
In Bangladesh, appropriate care-seeking for childhood pneumonia has remained more or less static over the years. Care-seeking from health facilities or health workers remained between 40%-50% in urban areas and 20%-30% in rural areas (Fig. 1). In the last DHS of 2007, there were huge disparities in care-seeking from health facilities or health workers with 17% among the poorest and 60% among the least poor - a more than threefold differential (Fig. 2). Care-seeking is affected by distance from

Fig. 1: Care-seeking for childhood pneumonia, urban vs rural, Bangladesh



Source: Bangladesh Demographic and Health Surveys

Fig. 2: Care-seeking for childhood pneumonia, Bangladesh, 2007

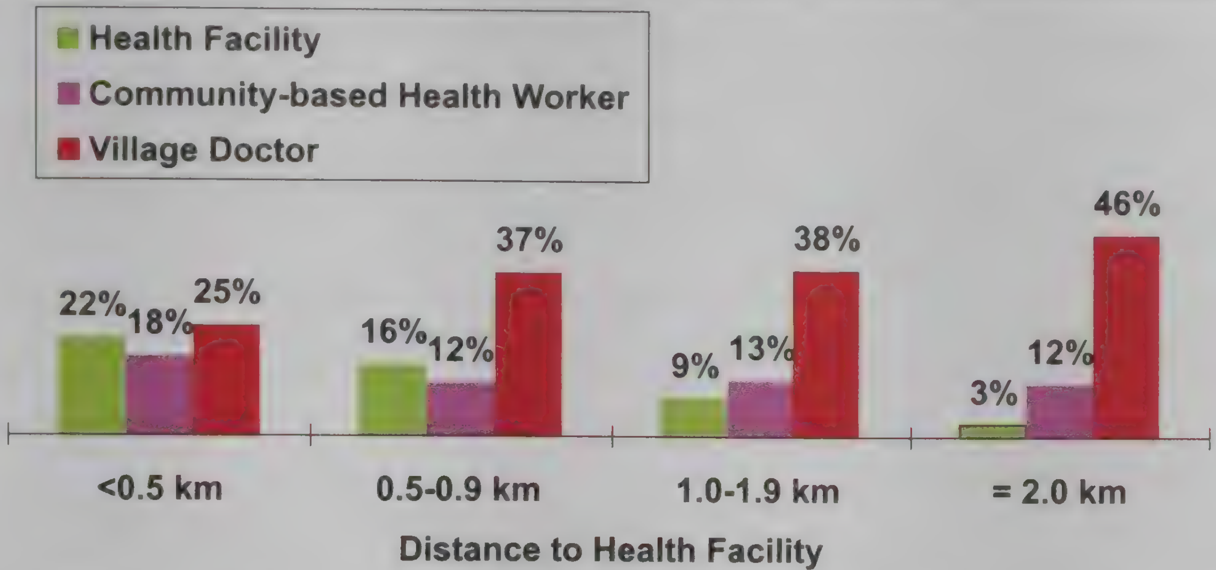


Source: Bangladesh Demographic and Health Survey, 2007

the health facility, with care-seeking going down very rapidly as the distance increases - 20% if within half a kilometre and less than 3% at more than two kilometre distance (Fig. 3). In contrast, seeking treatment from the informal village doctor increased from 25% to 46% as the distance to the health facility increased. Treatment rates from community-based health workers remained more or less static, irrespective of the distance to the health facility.

Data on the percentage of children with pneumonia treated with antibiotics is not available nationally. In a recent survey in 14 subdistricts of Bangladesh, generally considered higher mortality districts, at least 49% of the children with pneumonia received antibiotics. It seems the use of antibiotics is much higher than the care-seeking rates. Much of these antibiotics are prescribed by village doctors. Ethnographic work in the communities shows that village doctors are the preferred choice for health care as they are well-known members of the community, known to treat these conditions at a low cost, are available in close proximity seven days a week, and have a flexible payment system. The only way the formal health sector can compete with them is by adopting some of these attributes. This is important as there is a major concern about the quality of care and overuse of antibiotics by these so-called village doctors.

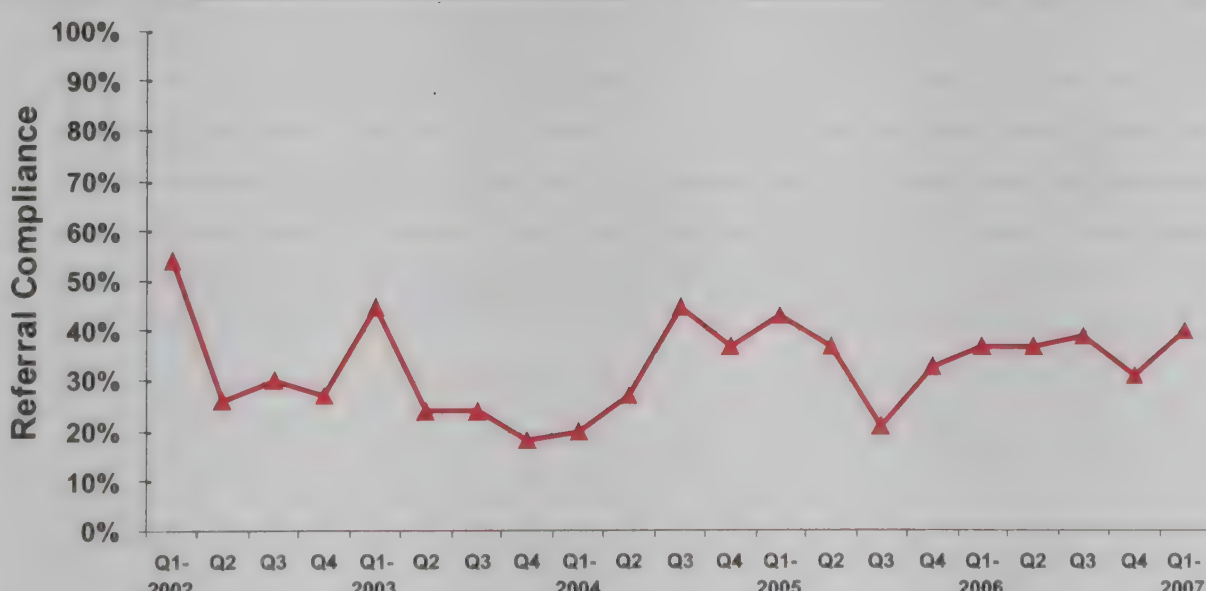
Fig. 3: Care-seeking for childhood illness, Matlab, 2005-2007



Utilization of 1st level government health is low and is severely reduced with increased distance, the difference being picked up by village doctors.

Referral is a critical aspect of the treatment of pneumonia. The Integrated Management of Childhood Illness (IMCI) guidelines, which is now the standard guideline for the treatment of sick children, recommends referral for all children with severe pneumonia seen at the first-level facility to a hospital. Data from the evalutation of IMCI in Matlab, Bangladesh, show that compliance with the referral advice is quite low, almost never above 40% (Fig. 4). Consequently, only about a third of the cases of severe pneumonia received correct treatment. The IMCI guidelines were modified with government approval so that if the child had only severe pneumonia without any other severe conditions or danger signs, he/she can be treated locally with oral amoxycillin. Subsequent to this, there was a threefold increase in the percentage of severe pneumonia cases correctly treated and with lower case fatality. It was evident that it was safe to provide treatment closer to home for uncomplicated cases of severe pneumonia.

Fig. 4: IMCI guidelines recommend referral for all children with severe illness



Low compliance with referral of severe illness; consequently, only about a third of severe cases receive correct treatment

Source: Multi-Country Evaluation of IMCI, Matlab`

At more than 1000 people in a square kilometre, Bangladesh is the most densely populated country in the world. The extreme level of crowding has string effects on disease transmission and on other living conditions that contribute to increased risk of disease. Bangladesh has an estimated 42 million people living in urban areas, which is likely to double in the next 20 years. Major adjustments will need to be made in health-care delivery systems to respond to this shift. There is a need to focus on urban areas which have a very different disease burden mix and practices. About 100 000 people live in the largest slum in Dhaka. Disease transmission increases in crowded areas with poor living and insanitary conditions, use of unsafe water and extreme air pollution. There are also issues of lack of social support for families with sick children. People migrating to Dhaka, and particularly those living in the slums, lack social support and have to take care of themselves and their families. Economic demands also mean that both parents may have to be working. They have to cope with inadequate time for child care and an extreme diversity of health-care providers. These problems will increase with increasing urbanization.

Diarrhoea and pneumonia prevention and control is now subsumed under the WHO/UNICEF's Integrated Management of Childhood Illness (IMCI) strategy initiated in the 1990s. IMCI aims to reduce death and disability and promote growth and development of under-five children. It includes both preventive and curative interventions and has three main components: improvements in case-management skills of health staff, health systems and community and family health practices. In many ways, IMCI was designed around treatment as a key strategy for child survival. At the core is the IMCI case management guidelines for health facility-based management. It promotes accurate assessment of illness of the child and appropriate treatment and improves the counselling of caregivers on appropriate care-seeking behaviours, improved nutrition and preventive care and correct implementation of the prescribed care.

In 2006, IMCI in Bangladesh moved away from being a strategy and acquired the status of a programme with the merger of previous acute respiratory infections (ARI) and diarrhoea control programmes into it. An effect of this was that all support from WHO/UNICEF that had been historically for ARIs and diarrhoea was shifted to IMCI, severely affecting programmes in areas where IMCI has not yet been scaled up. IMCI implementation in Bangladesh is also characterized by an emphasis on health-facility worker training. There was an underlying assumption that IMCI will be dealing with all five main causes of child deaths - diarrhoea, pneumonia, measles, malnutrition and malaria. However, the programme lost sight of the fact that the control of pneumonia required other interventions to happen as well to achieve the reduction in child mortality; for example, the use of antibiotics, breastfeeding, reduction in indoor air pollution, immunization, etc. It is critical that we carefully assess what needs to be done comprehensively to reduce the burden of pneumonia and diarrhoea.

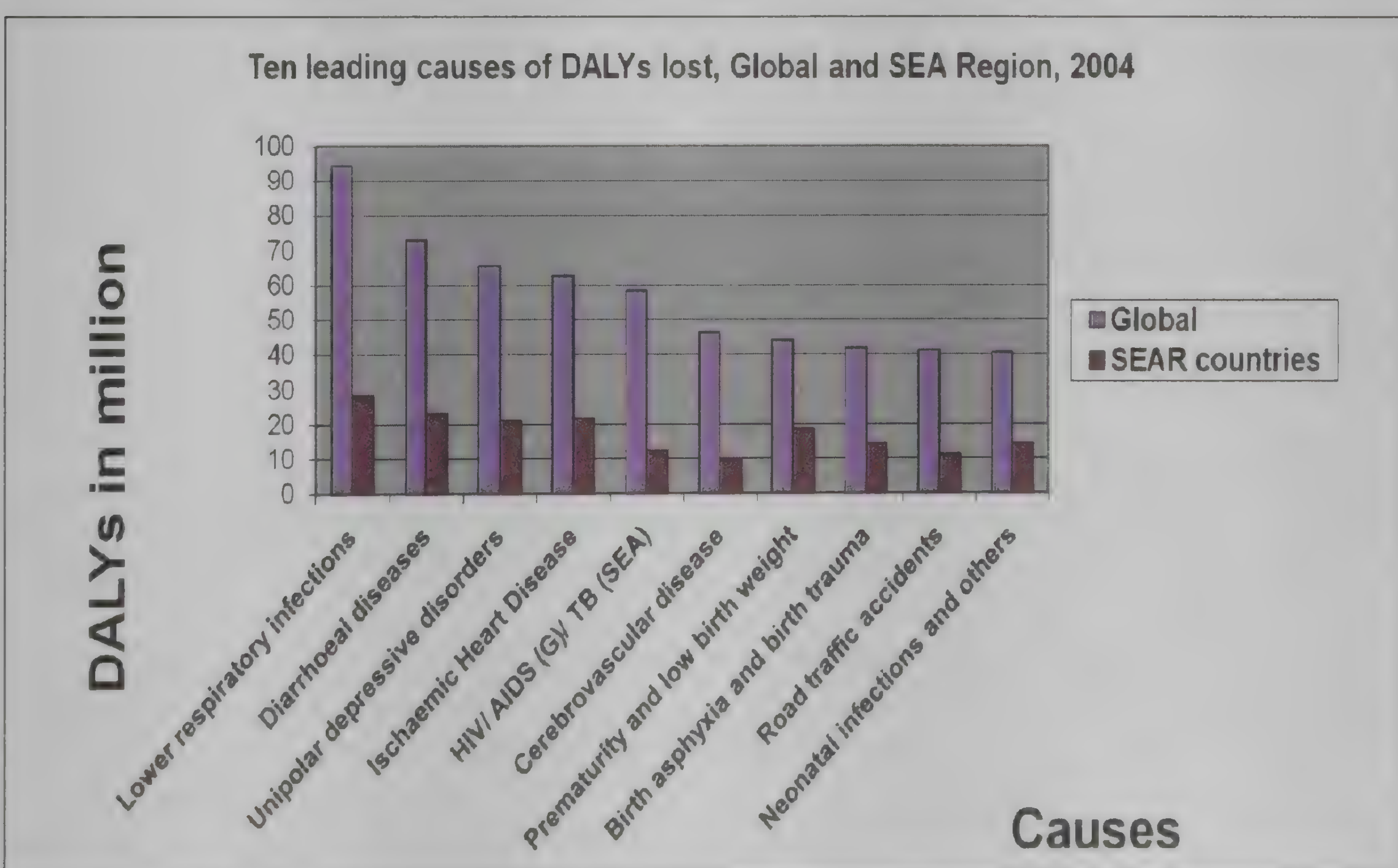
In 2006, UNICEF and WHO released a report on pneumonia as 'the forgotten killer' of children. This has now been followed by a global action plan for the prevention and control of pneumonia. It basically highlights three interventions that need to be implemented at scale and high coverage: (1) protection of children by providing an environment so that they have a low risk of pneumonia, i.e. promotion of breastfeeding, adequate nutrition, preventing and reducing air pollution and increased hand washing; (2) preventing children becoming ill by vaccination with DPT, measles, Hib and pneumococcal vaccines, preventing and treating HIV, and providing zinc as part of treatment of diarrhoea; and (3) treatment of children who become sick with pneumonia. The action plan includes recommendation to countries to take actions in terms of designating, preferably an existing group, to take on this charge, generating political will through advocacy, and undertake a situation analysis for pneumonia involving other programmes; for example, hand washing, sanitation and indoor air pollution. The areas of collaboration within health services include increasing the coverage for vaccination as well as access to case management which is currently not very high. Most importantly, a way has to be found for tracking progress. Interestingly, for pneumonia, there is no data on a key indicator, i.e. the percentage of pneumonia that is treated with antibiotics.

Integrating prevention and control of acute diarrhoea and respiratory infections in the WHO South-East Asia Region: a new initiative

Madhu Ghimire

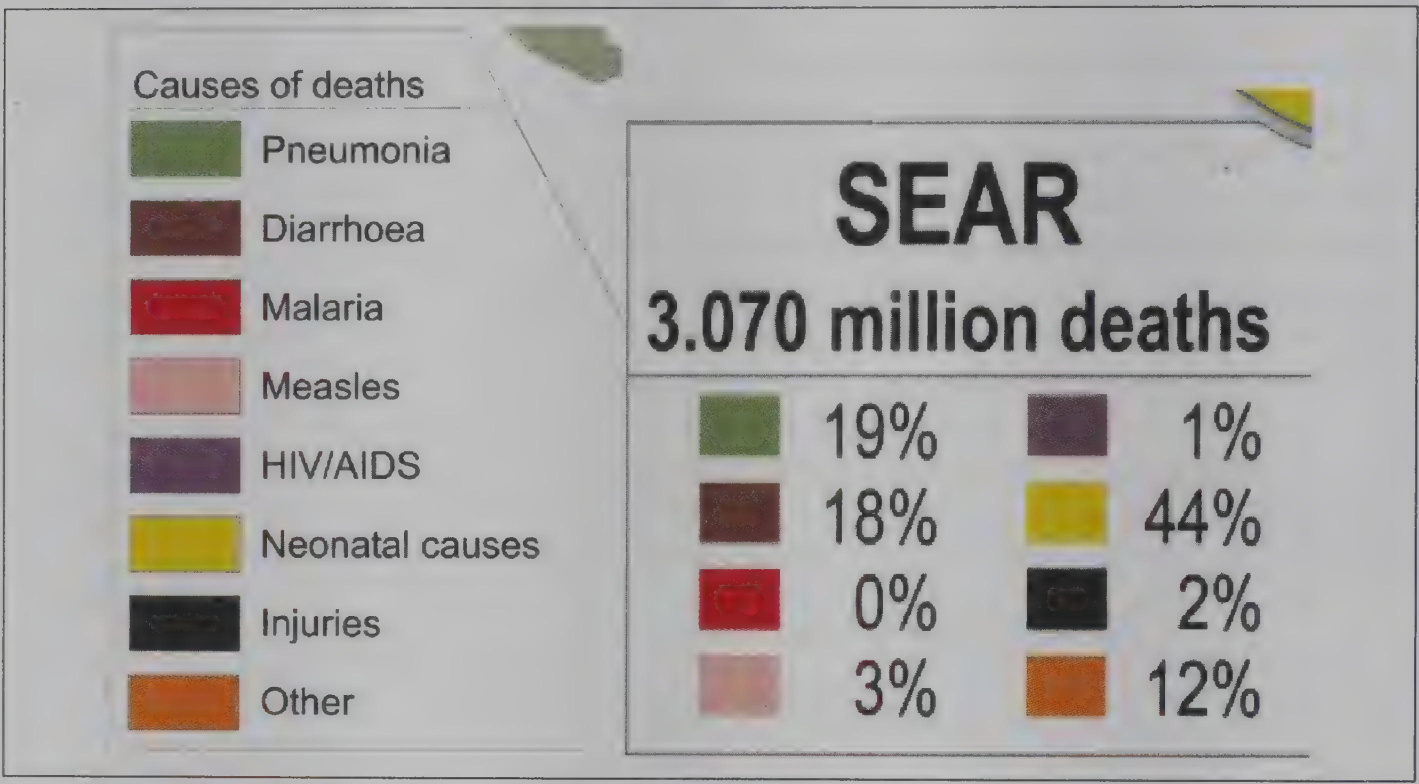
Acute diarrhoea and acute respiratory infections (ARI) are forgotten priorities. In recent years, political and programmatic commitments to these health problems have receded because of various competing interests. Safe, effective and fairly inexpensive interventions have been available for almost four decades. A new initiative is required in the WHO South-East Asia Region which carries a high burden of these diseases. Respiratory and diarrhoeal diseases are the leading causes of disability-adjusted life years (DALYs) worldwide, which account for 90 million and 70 million DALYs respectively. Lower respiratory tract infections (RTIs) account for 28-29 million DALYs and diarrhoeal diseases are responsible for 23 million DALYs (Fig. 1) in the Region. These are also the leading causes of mortality, not just in children but also in other age groups. Across the age spectrum, respiratory infections accounted for more than 1.4 million deaths and diarrhoeal deaths numbered almost 700 000 in 2004 *(1)*. Out of 3.1 million deaths among under-five children from all causes in the Region, respiratory infections and diarrhoea accounted for 19% and 18% deaths respectively (Fig. 2) *(2)*.

Fig. 1: Leading causes of DALYs lost, global and WHO SEA Region, 2004



In the last five decades, there has been no discernible change in the incidence of diarrhoea in children. The mean age-specific incidence and the overall incidence has not changed *(3,4,5)*. Towards the end of the 1970s, the diarrhoea-proportionate mortality was around 25%; thereafter, the mortality steadily declined by around 1% every year to almost 13%-14% towards the end of the 1990s. It went up again towards the end of the last millennium to 18% *(6)*. There is an inexplicable paucity of data for the disease burden of diarrhoea in adult population. In 2007, a study in Hanoi, Viet Nam, among waste water-exposed agriculture-based population showed 28.1 episodes per 100 persons at risk *(7)*. A recent estimation of deaths in more than five-year-old population worldwide is over 1.1 million every year. More than 90% of these deaths occur in the WHO South-East Asia Region and sub-Saharan Africa *(8)*.

Fig. 2: Leading causes of death among under-5 children, 2004



Acute respiratory infections (ARIs) cause about one third of the morbidity in the above five-year-old age group. ARIs account for 8.5% of total DALYs lost worldwide, and 6.2% of DALYs are lost from pneumonia. The average morbidity rate from ARIs in children is around five episodes per child per year. The incidence has not changed over decades. The annual number of new cases of pneumonia in under-five populations is around 156 million globally and 61 million in countries in the Region. Around 10% of these cases require hospitalization. More than two million deaths occur in under-five populations worldwide, and 0.6 million deaths are in the Region *(9)*. The annual incidence of community-acquired pneumonia in the elderly population varies from 25 to 44 per 1000 population, and the mortality rates could be as high as 30% in the elderly *(10)*. In the regional countries, non-tubercular and non-HIV-related lower respiratory infections are the cause in more than 10% of all deaths each year *(11)*.

The commonly recognized risk factors have been unsafe water and sanitation, poor domestic and community hygiene practices, suboptimal child rearing and health- seeking behaviour, malnutrition, indoor air pollution, poor access to health care, lack of outreach health programmes, suboptimal coverage by immunization programmes and unavailability of antiretroviral treatment (ART). The vulnerable population for both diarrhoeal and respiratory infections has been in rural and remote communities, tribal populations and urban slums with poor living conditions. Infants, young children, sick and malnourished children and the elderly are most vulnerable to both pneumonia and diarrhoea.

An evaluation in 2006 by the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation indicated that the sanitation situation remained poor in the Region. Approximately 282 million people lived with unsafe water supply and 975 million people were without proper sanitation facilities. Almost 766 million people practised open defecation. Improved hygiene practices like hand washing have been shown by several studies to reduce the disease burden drastically. But, even in communities where the knowledge is good, the practice of hand washing is dismal. Only around one third of the people who know about its benefits actually practise it. Even when hand washing is practised, the use of soap or ash is not common. People simply rinse their hands with water *(12)*.

Intervention such as availability of water and its quality at the point of use improved sanitation and improved hygiene practices have been shown to result in a drastic reduction in the incidence of diarrhoea. Other hygiene practices, such as cough etiquette, hygienic disposal of respiratory secretions and dental hygiene have impact on the respiratory disease burden. Because of the lack of services at community level, regular and timely interactions between the health worker and caregivers do not take place, and basic child care, such as keeping the child warm and clean, minimizing indoor pollution, timely immunization and early care-seeking for illness, falters. Nutrition of the child, including breastfeeding practices, has not been promoted adequately; supplementation of important micronutrients, such as zinc, and proper education on food preparation and feeding has not been taking place in communities.

Improvement in breastfeeding practices by commencing exclusive breastfeeding early after birth, preferably within the first hour, and continued exclusive breastfeeding for six months and continued breastfeeding for 12 months or beyond can reduce child mortality by 13%. Improved complementary feeding can reduce the incidence of malnutrition by up to 20%, diarrhoeal deaths by 10% and overall child mortality by 6% *(13, 14, 15)*. There is plenty of room for improvement in exclusive breastfeeding in the Region. All high-mortality and high-burden countries have low rates of exclusive breastfeeding. Even when exclusive breastfeeding is practised, it is practised for less than four months in many countries. Breastfeeding plus complementary feeding from six to nine months in infancy is quite high but its quality, appropriateness and timeliness is not adequate.

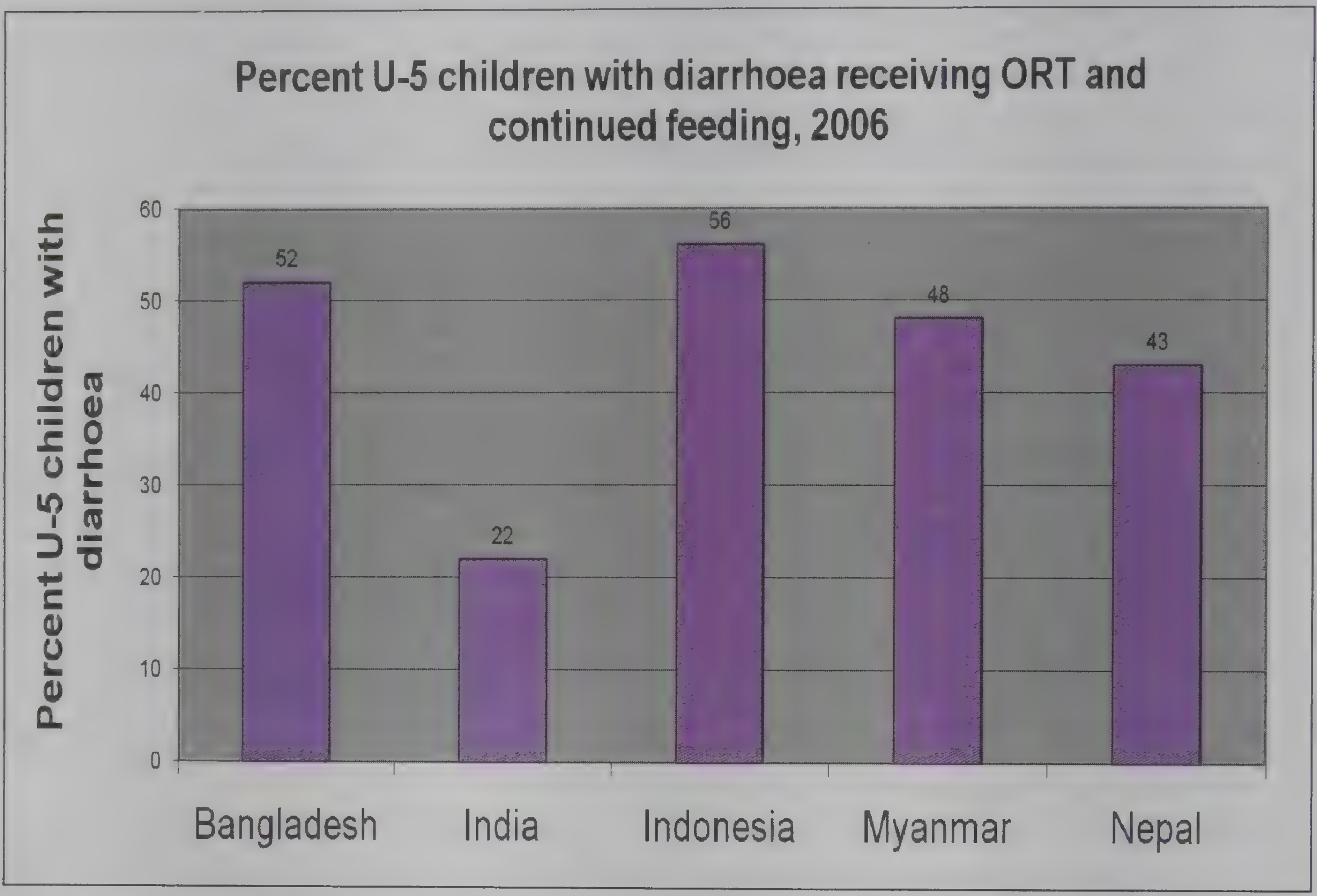
Zinc deficiency in developing countries is a very common phenomenon. It has contributed to the burden of diarrhoeal illnesses and pneumonia. Zinc deficiency occurs basically because there is limited access to zinc-rich food in population. There is poor absorption of zinc from the gastrointestinal tract due to the formation of chemical complexes with high hydrates and phytate contents in regional diets, and there is also exaggerated consumption and loss of zinc because of frequent infections and diarrhoea. Supplementation trials of zinc have shown remarkable reduction in the incidence of diarrhoea to the extent of 14%, severe diarrhoea 16% and persistent diarrhoea 25%. ARI incidence after zinc supplementation is reduced by 8% and pneumonia by almost 21% *(16)*. Undernutrition is common in the Region and the situation is not improving. If at all there is improvement, the pace has remained painfully slow. With the advent of newer tools to examine infant growth, stunting, wasting and low weight among infants are found to be more common than previously realized. Malnutrition starts occurring at a very early age of six weeks *(17)*.

There are many studies showing a very good correlation between indoor air pollution and respiratory infections. The incidence of pneumonia almost doubles with bad indoor atmosphere. The major cause of indoor air pollution has been the use of unprocessed solid fuel. There is hardly any ventilation in the rooms but house- owners have to use energy from these sources to keep the children warm and also to do the cooking.

Access to and utilization of health care services also remain poor in most countries in the Region. The estimated number of deaths from measles every year is still around 150 000. About 82 710 cases of measles were reported in the Region in 2008. Inadequate coverage of DPT also adds to the pneumonia burden. Most of the deaths associated with measles are caused by pneumonia. Despite the accelerated

vaccination programmes, the coverage of measles has stayed around 75%. The behavioural problems related to care-seeking are causing these gaps. The proportion of under-five children with suspected pneumonia taken to a health-care provider does not exceed 70%. In most countries of the Region, it is only around 20%-25%. Mere 22% of under-five children with diarrhoea receive oral rehydration therapy (ORT) and continued feeding in India, which has the highest burden of this disease among all countries in the Region (Fig. 3).

Fig. 3: Access /utilization of health care service



A new initiative is imperative for pneumonia and diarrhoea prevention and control. Preventive interventions in the new initiative should prioritize hygiene practices, nutrition and immunization coverage. Piloting and introducing new cost-effective vaccines, such as oral cholera and rotavirus vaccines, and perhaps even Hib and pneumococcal vaccines whenever a need is felt for these, should be the next step. Preventive interventions such as hand washing and water quality improvement at the point of use need sustained efforts to maintain a high level of adherence. Solar disinfection or chlorination of water at the point of use, community mobilization and behavioural change interventions to improve personal and community-level hygiene and sanitation should be considered. Minimizing indoor air pollution is another important area requiring both research and immediate adoption of the available practical tools. Case management would require further strengthening by building capacity of community health workers and caregivers aimed at standardizing the community-level management of these conditions at home. Similarly, the facility-level management needs to be strengthened by improving the infrastructure and the capacity of community and facility-level health workers. Case management of acute diarrhoea at home would consist of preventing dehydration with oral rehydration therapy (ORT) and continued feeding, making mothers aware of the danger signs and improved care-seeking. Health care workers need to assess the degree of dehydration, provide oral rehydration and continued feeding to those with 'some dehydration', and dispense, with clear instructions to the caregiver of young children, oral zinc supplement for 10 to 14 days. Referral of cases with 'severe dehydration' or danger signs to a health facility, use of antibiotic for suspected cholera with severe dehydration, and use of antibiotic for acute

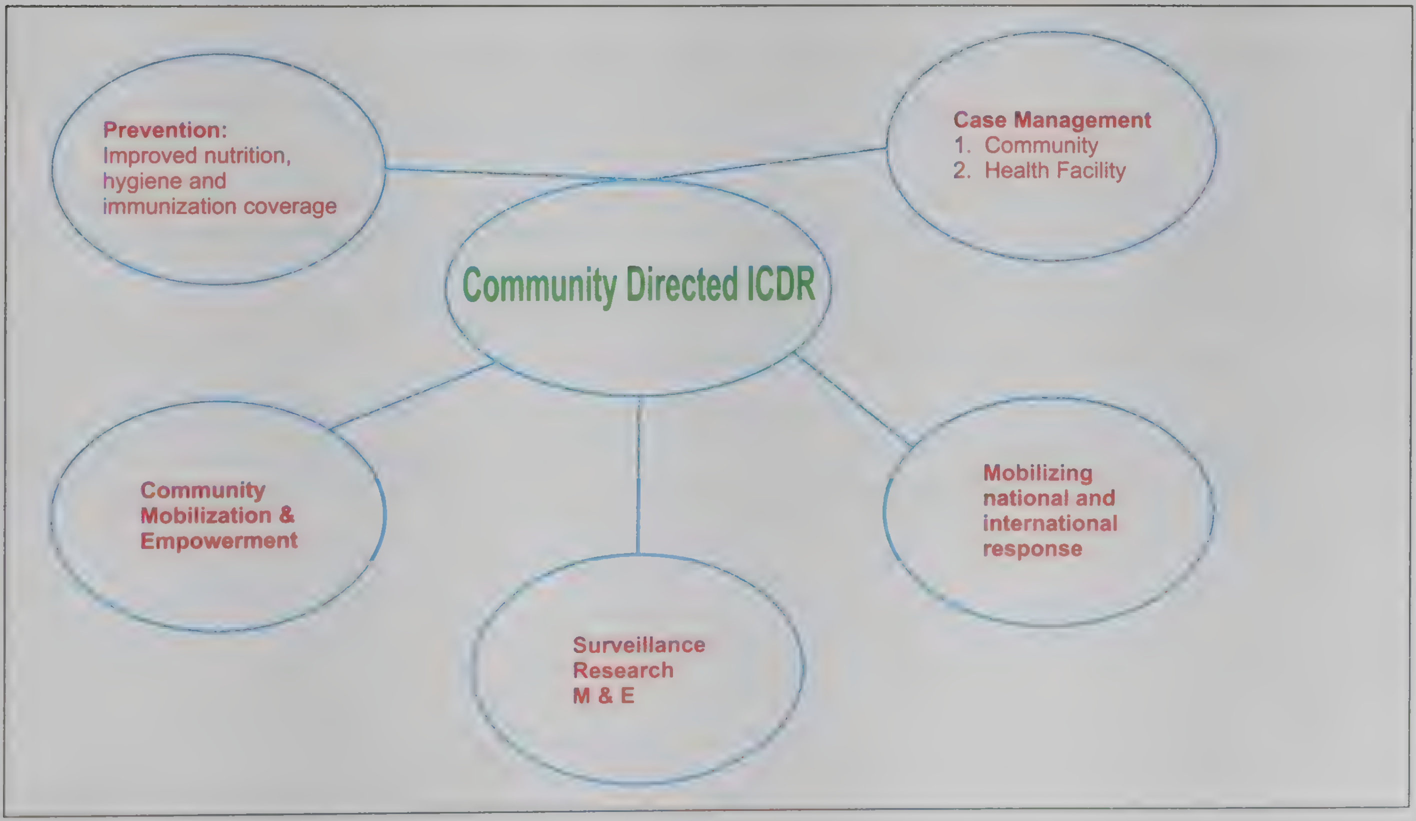
bloody diarrhoea, intense feeding after rehydration and counselling to caregiver on prevention would constitute the appropriate next steps in case management.

Case management of young children with acute respiratory infections should follow the standard WHO guidelines for the diagnosis of pneumonia by counting respiratory rates and assessing the severity of pneumonia by observing for the presence of lower chest wall in-drawing. Caregivers of the non-pneumonic cases of ARI should be advised regarding the supportive treatment. Oral antibiotic, according to the national protocol, should be dispensed with appropriate instructions to those with uncomplicated pneumonia. Caregivers at home should also be instructed on appropriate care-seeking for any worsening of condition. Those with worsening of the condition despite the treatment and those with danger signs should be referred to a health facility without delay.

The case management of acute lower respiratory tract infection in adults would consist of developing simple diagnostic protocols, piloting the diagnostic tool at the community level, treating the diagnosed cases in a well-ventilated room, those with bacterial infections with appropriate antibiotics, and adding long-acting oral theophylline preparation for those with audible wheeze. Cases with significant hypoxia, indicated by oxygen saturation of less than 88% in previously non-hypoxemic patients and a falling oxygen saturation in previously hypoxic but stable patients as monitored by using pulse oximeter, need to be referred to a facility for treatment with oxygen. Monitoring symptoms, general well-being and oxygen saturation, and referral of those getting worse over the next 24 to 48 hours to a health facility should be included as part of the case-management protocol.

The direction of this new initiative should be towards integrating preventive interventions with case management in all age groups. These interventions should have a foundation in community mobilization and empowerment (Fig. 4). Advocacy and awareness creation is required in order to promote a community-directed intensified prevention and control programme in the Member States of the Region. Main interventions for prevention and case management at both community- and health-facility levels should be supported by appropriate training of health workers, improved and well-coordinated logistics, a well-designed programme for surveillance and research, and, even more importantly, proper monitoring and evaluation. Mobilization of national and international response is necessary for launching the new initiative.

Fig. 4: Strategic framework for community directed ICDR



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Parallel Session 4

Disease epidemiology, modelling and innovation

Chairpersons: *N.K. Sethi*
Laurette Dube

Session Coordinator: *Manoj Das*

A Brain-to-Society approach to chronic disease prevention and epidemiology – *Laurette Dubé*

Uses and development of Geographic Information System (GIS) technology in epidemiological research – *Mark Daniel*

A Brain-to-Society approach to chronic disease prevention and epidemiology

Laurette Dubé

Introduction

The Brain-to-Society (BtS) approach to chronic disease prevention and epidemiology has been developed as the scientific anchor of the McGill World Platform for Health and Economic Convergence (MWP). The MWP is an unique initiative anchored in McGill University's Desautels Faculty of Management and Faculty of Medicine. The traditional divide between market, economy and society has created challenging environmental conditions for human health and well-being. The MWP is rooted in the conviction that by harnessing the power of the best minds and leading organizations in the health, social, business and economic sectors operating at local, national and global levels, and that of the most recent developments in genetics, neuroscience and computational systems sciences, this divide and the complex issues at the interface of health and economics can be bridged. The MWP's mission is to foster developments in science, policy, innovation and education to mainstream health into management and economic decisions impacting health and health care, and, conversely, to weave management and economic considerations into public health and health care systems design and delivery. What follows is a brief description of the key tenets of the Brain-to-Society (BtS) approach as well as an overview of some of the early research findings. It ultimately offers a new model that could be tied to the study of epidemiology to yield more positive health outcomes in a biologically and economically sustainable manner around the world. Indeed, many features of the BtS approach could enrich traditional disease epidemiology and lead to better interventions on the ground.

Background

The Brain-to-Society approach to chronic disease prevention and epidemiology aims at articulating a new science of the *hows* to feed – and be fed by – complex collaboration and innovation across disciplines, sectors and jurisdictions. This will allow us to scale up our abilities to address issues that lie at the interface of biology and modern society. It capitalizes on cutting-edge methods, metrics and models from genetics, neuroscience and computational systems science, and integrates them with those of health, behavioural, social, agricultural, business and economic disciplines. The BtS approach also builds upon the ground-breaking accomplishments of the Human Genome Sequencing Project (Individual-Level Diagnostic) and the approach to environmental research and action pioneered by the 2009 Nobel Laureate, Elinor Ostrom (Societal-Level Diagnostic).

The Individual-Level Diagnostic will examine the degree to which individual differences in genetics, neuro-cognition and socio-environmental exposures modulate behaviour, body weight and nutritional risk over time. The Societal-Level Diagnostic examines the exposure conditions that emerge from the single and combined impact of policy, investment, business and social innovation from various stakeholders.

The BtS approach is anchored in a networked research programme which takes a transdisciplinary, multisectoral and multilevel approach to the study of lifestyle choices that impact health and health care. Its first point of focus is food choices and diet. The BtS programme is unique in that it examines individual choice as the joint outcome of gene, brain and society. From this perspective, biology influences individual choice and behaviour, and is in constant interaction with the environment. Both biology and the environment are part of the same complex system in need of alignment. The BtS programme was designed to fill a gap in traditional research activities that sought to address complex health issues – such as obesity and chronic disease prevention – from a simplistic perspective. The research agenda is supported by provincial, national and international health, social science and humanities funding agencies.

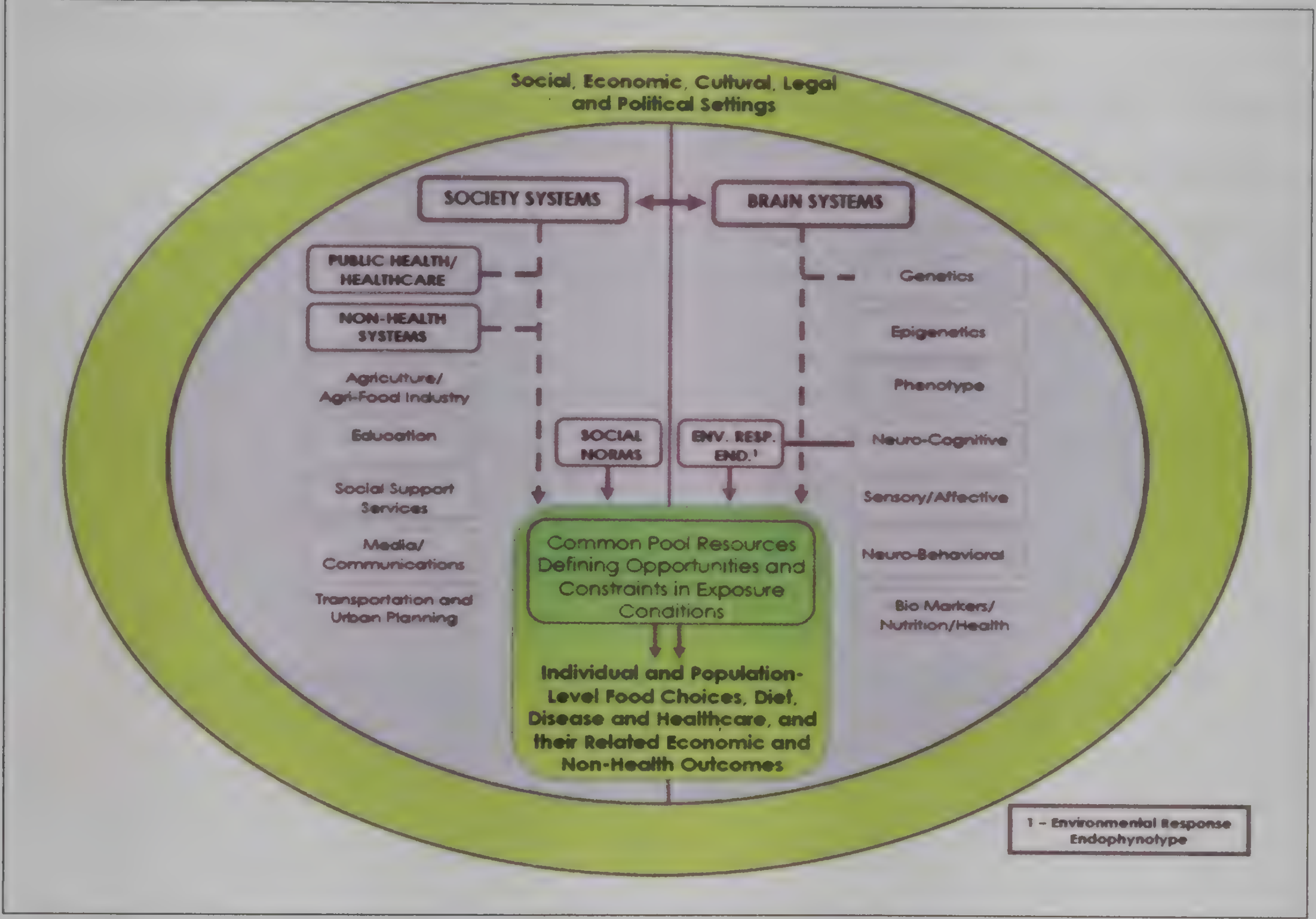
Fig. 1: Malnutrition and obesity are widespread

It is through the examination of the issue of obesity and chronic disease around the world that the BtS approach was conceived. A first cycle of activities – from 2005 to 2008 – focused on childhood obesity prevention. Its flagship event – an annual think tank – created a forum for stakeholders from business, academia, government and civil society working at different levels and across different sectors to address the common issues lying at the interface of health and economics. These think tanks have attracted world leaders, including, among others, Nobel Laureates Paul Krugman and Daniel Kahneman.

Overweight and obesity (Fig. 1) represent a huge health challenge to developed societies and a growing problem in developing countries. According to WHO, approximately 1.6 billion adults were overweight in 2005 and 400 million adults were obese. Furthermore, WHO estimates that, by 2015, these numbers will rise to 2.3 billion and 700 million respectively *(1)*. Moreoever, whereas once overweight/obesity was a high-income-country problem, it is now dramatically rising in low- and middle-income countries, particularly in urban settings *(2,3)*. In emerging markets, such as China and India, the obesity epidemic is further compounded by ongoing malnutrition and regular waves of communicable diseases. This double burden of communicable and noncommunicable diseases poses a huge strain on societies that may not necessarily have the health infrastructures to address such public health problems. Indeed, as overweight and obesity are closely tied with economic growth *(4)*, it is increasingly vital that we find a way to ensure that the benefits of economic development are not offset by the high toll of chronic diseases.

In closing this cycle of activities, the MWP produced an exhaustive collection of articles on obesity entitled *Obesity Prevention: The Role of Brain and Society on Behavior*. Published in June 2010 by Elsevier, it outlines in great detail the main precepts of the BtS approach. Contributors include Jaak Panksepp, Prabhu Pingali, William Killgore, T.N. Srinivisan, William Bernstein and Catherine Le Galès, among others.

Fig. 2: Outline of the Brain-to-Society approach



The BtS approach to obesity prevention assumes that neither individual biology nor the environment can singly account for individual and collective lifestyle choices. Rather, to effectively address overweight/obesity and its related chronic diseases around the world, an integrative approach, rooted in an in-depth understanding of the pathways of motives, antecedents, actions and consequences within each level of influence on obesity and at their interface, is needed (Fig. 2). A new scientific basis must be developed that can guide changes in policy and action that will ensure that our environment does not overshoot the limits of human biology.

The BtS approach, for starters, views the 'brain' and 'society' as two elements of the same complex and dynamic adaptive system. It identifies and analyses relationships among multiple levels within various tiers of the complex web of 'brain' and 'society' systems that operate at different spatial, temporal and administrative scales. The objective is to identify why certain personal, familial, social and commercial innovation, policy intervention or institutional change universally work while others do not.

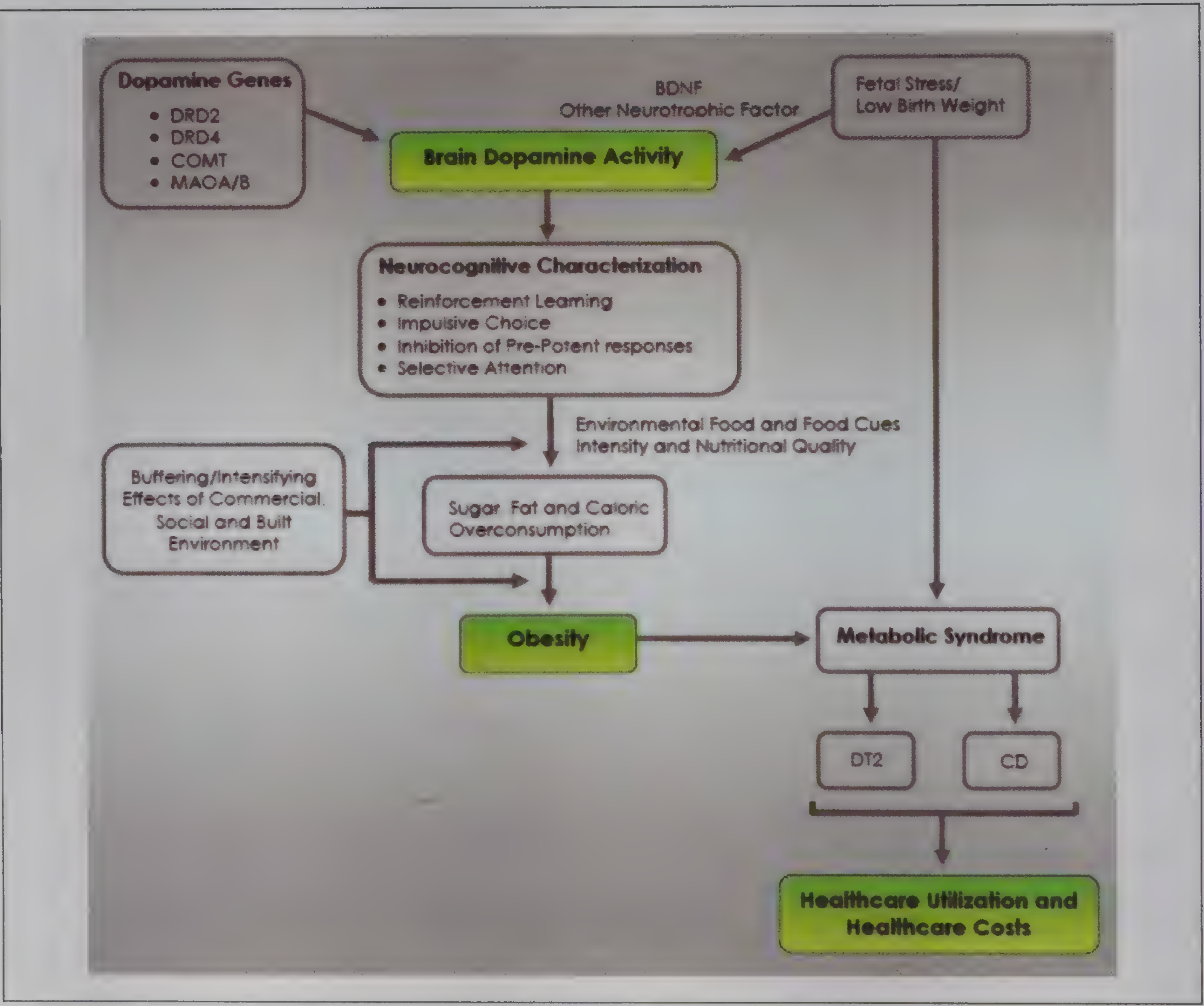
It also seeks to specify the multiple contingencies that define individual and system-level responses to change and account for their dynamic and evolving nature. This approach calls upon top-down and bottom-up computational systems science to bridge the different levels of theories, data and evidence bearing on individual choices and their underlying biological and environmental determinants.

Thirdly, it also posits that individuals vary in their genetic and neurocognitive vulnerability and resilience to environments. These differences are traceable in normal populations, although some processes are more critical than others with regard to 'self-control' in response to environmental cues. Also, environments vary in the diversity and intensity of challenging/protecting exposure conditions they present to biology, and as a function of their ability to create a choice architecture that fosters adaptive healthy choices. Contextual differences exist in the balance of eating opportunities and constraints in the environment on each choice occasion. Finally, the balance of eating opportunities and constraints in the environment is shaped by choice made by actors in health and non-health sectors.

The Individual-Level Diagnostic: gene, brain and behaviour in variable environmental conditions

Brain systems here refer to genetics, epigenetics, phenotypes, neurocognitive systems, sensory and affective systems, neurobehavioural systems, bio-markers, and nutrition and health. The Individual-Level Diagnostic is rooted in the genetic and neurocognitive characterization of environment-responsive endophenotypes (EREs), these serving as a theoretical and methodological bridge between gene, brain, behaviour and society. EREs are developed to improve our ability to recognize and map individual differences in the complex mechanisms by which biology and environment guide the eating behaviour. They can facilitate the identification of vulnerable and resilient individuals and groups, and inform the rational development of tailored interventions and policy change in regard to chronic diseases.

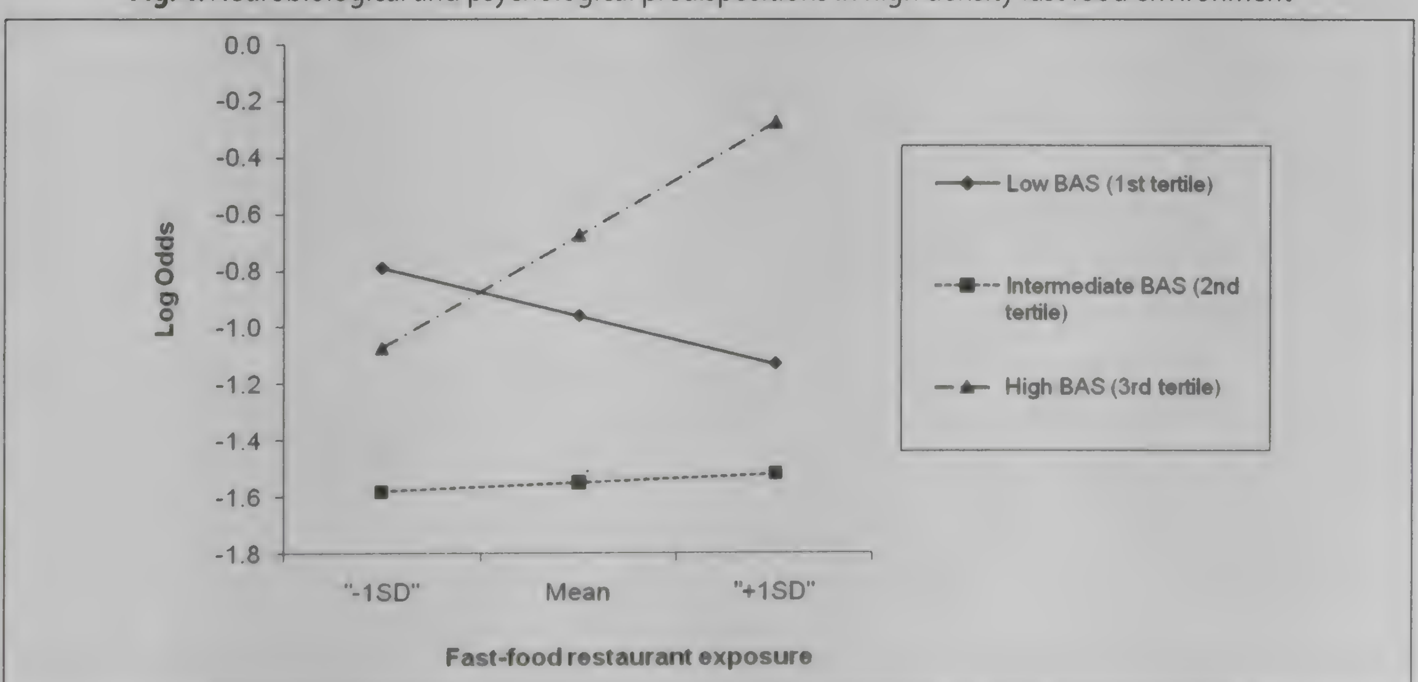
Fig. 3: Gene, brain and behaviour in obesity



The hypotheses that guide ERE development are rooted in the working model illustrated here (Fig. 3). Genetic and neuroscience research supports the central role of dopamine systems in eating behaviour and, more generally, in guiding individual responses to environmental cues. Excessive consumption is viewed as a key factor in overweight/obesity, translating into chronic diseases with consequent health care costs. There are two major brain dopamine pathways: (i) the mesocorticolimbic pathway from the VTA to the limbic system; and (ii) the mesostriatal pathway from the substantia nigra to the striatum. Dopamine responses define the salience or incentive value of a stimulus and shape cognitive processing and behaviour directed towards more salient stimuli. Drugs of abuse activate the central dopamine pathways, as do food stimuli. Sweet and fatty foods potentiate dopamine release, induce more pleasurable feelings, and are more rewarding. The continuous increase in obesity prevalence has been related to the increase of fatty and sweet food and food cues in the modern environment. These are tied to business practices related to consumer education, product formulation and labelling, merchandizing, advertising, pricing and promotion. Recent research suggests that the abundance of highly palatable food in the modern environment may have differential effects as a function of genetic and neurocognitive differences in an individual's reward circuitry and executive control responses.

The Individual-Level Diagnostic proposes two mechanisms to document the relationship between dopamine signalling and food reward and consumption. The first is the reward sensitivity hypothesis, which suggests that individuals who are more sensitive to reward consume more food. The other is the reward deficiency syndrome, whereby individuals who are less sensitive to reward, consume more food in order to overcome their sluggish reward circuitry. It is argued that both these pathways may reflect an 'at-risk' phenotype. This depends upon the genetic predisposition in dopamine signalling that is reflected by the presence (or absence) of A1 allele of the TaqA1 and of the exon 3 7-repeat allele of the DRD4 gene. This research found that individuals who show weaker activation of brain-reward circuitry in response to the imagined intake of palatable foods were at an elevated risk for future weight gain if they were also at genetic risk for dopamine signalling. In individuals who do not possess the Taq1A1 allele of the DRD2 gene and the exon 3 7-repeat allele of the DRD4 gene – and therefore were not a genetic risk for dopamine signalling – it is the more intense dopamine signalling responses that become a risk factor for increased BMI (body mass index). These findings suggest that experiencing too little or too much reward from food may paradoxically increase the risk of obesity. Therefore, experiencing moderate reward from food might serve as a protective factor. This research points to the possibility that the two extreme endophenotypes of high-reward-seeking/high restraint and low-reward-seeking/low restraint may respectively be the most at risk/most protective in regard to neurocognitive and genetic vulnerability.

Fig. 4: Neurobiological and psychological predispositions in high density fast food environment



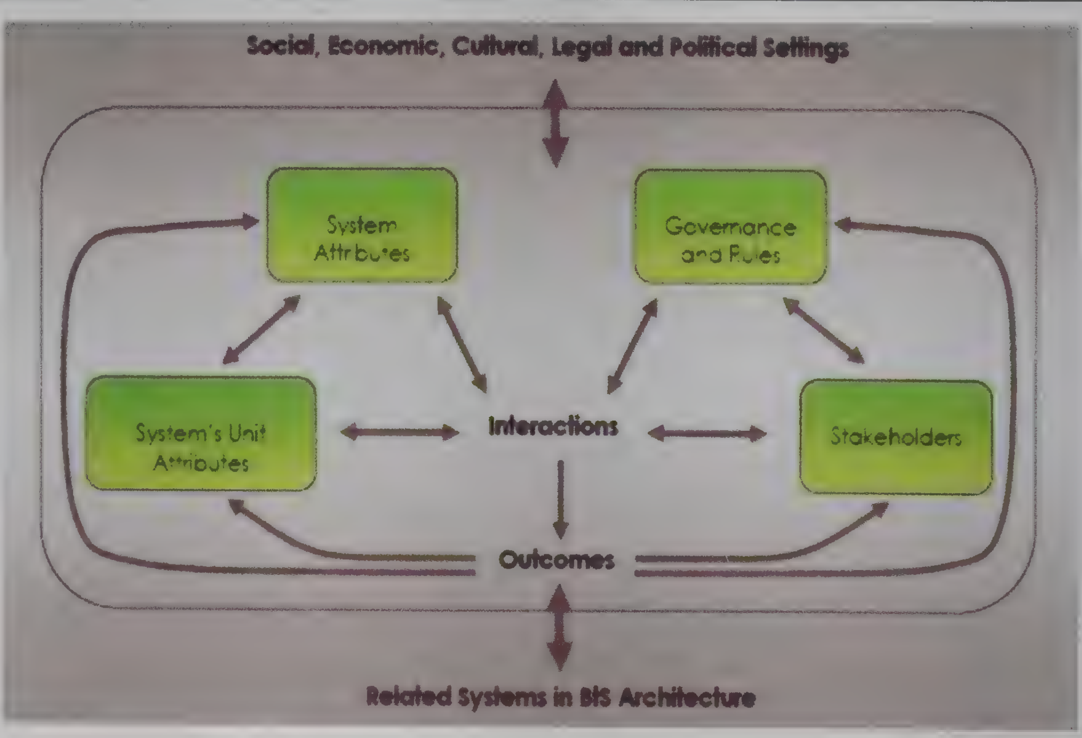
Paquet and colleagues *(5)* found, that controlling for income and education, high-reward-seeking individuals with a neurobiological and psychological predisposition to respond to environmental cues with intense behaviours are especially vulnerable to the density of fast food in their neighbourhood (Fig. 4). For these individuals, an increase of one standard deviation in fast-food restaurants was associated with a 49% greater likelihood of having visited a fast-food restaurant in the previous week. At the population level, such a relationship was not significant. Yet, looking more closely at the vulnerability of the high-reward-seeking segment of the population, they were more likely to be individuals with low incomes and education levels. In light of the fact that fast-food density is typically higher in low socioeconomic neighbourhoods, there is a compounding effect of biological and environmental risks for individuals with low incomes and low education levels.

The Societal-Level Diagnostic: health, social and economic systems that shape the environment

The Societal-Level Diagnostic draws upon sustainability science and is rooted in the work of 2009 Nobel Laureate, Elinor Ostrom *(6,7)*. The BtS Diagnostic approach at the local community level, as well as in examining higher-level broad society systems targeting obesity prevention, is designed to put together a more sophisticated account of the within- and cross-system diversity of interactions. It examines how they are interconnected with broader influences operating at the municipal, regional, national and global levels, and how they change over time in response to obesity prevention interventions and other societal changes.

The 'brain' system interacts in complex ways with the environment in which human beings make eating and lifestyle choices. The BtS approach assumes that the balance of health-promoting or health-challenging opportunities/constraints in an environment result from the single and collective actions of government, business and community organizations in health and non-health society systems (agriculture and food systems, education, transportation and urban planning, media, etc.) (Fig. 5). The environment and society systems is comprised of both health and non-health actors. Health, of course incorporates public health and health care. Non-health actors include food and agriculture, education, social support services, media and communications, transportation and urban planning. The BtS approach aims at developing concepts and tools to study individual biological responsiveness to the environment. As such it also examines environmental conditions and societal systems from the perspective that they are the result of societal action. A crucial component of this means understanding HOW societal systems operate in order to shift them to a more sustainable direction.

Fig. 5: BtS and social, economic, cultural and legal settings



The figure here illustrates the core components of within- and cross-systems analyses through a diagnostic of actors, motivations, trends, governance, and other institutional arrangements that contribute to organizational choice and shape the environment in which individuals, family and communities operate. As can be seen, each system is comprised of first-level core subsystems – here identified as the nature of the system and its attributes; the core production units of the system, the main stakeholders involved at individual level as well as in local, national and global governments, in the private sector, and at community levels, and the various types of governance and rules – which are each made of second-level variables, then decomposable in deeper-level variables *(7)*. The Societal-Level Diagnostic proceeds through knowledge synthesis and field examination for six levels of analysis: (i) the system attributes; (ii) the system outputs; (iii) stakeholders; (iv) rules and governance; (v) the interactions between stakeholders; and (vi) the outcomes in regard to healthy eating and physical activity, within social, economic, cultural, legal and political settings at local and national levels, taking into consideration the global-level sphere of influence as well.

Conclusion

In regard to diet-related health outcomes, individuals as well as communities, organizations and systems interacting in contemporary societies to drive food supply and demand have complex motives and operate on multiple scales to generate productive and innovative as well as destructive and perverse outcomes for society as a whole, as well as for themselves and their respective sectors. This applies in particular to industries whose offerings shape the dietary energy balance, whether through agriculture and food, television and media, computer and other technologies or through transportation and urban planning. Centres of decision-making that are formally independent of each other become, in fact, part of the same system. Together, this produces deeply-nested challenges in aligning modern society with the power and limits of human biology where health, economic performance and other local, national or global outcomes cannot be targeted and monitored independently of each other.

These ‘nested challenges’ have thus far not been addressed successfully because of the clear boundaries set by the two-pronged institutional frameworks underlying modern society since the onset of the Industrial Revolution. This framework is anchored, on the one hand, in market mechanisms aligning industry supply with consumer demand and, on the other, in social and political governance for market regulation and non-market domains, such as health and human development, funded by taxes and other public or philanthropic sources. It is assumed that what business does best is doing business and, therefore, health and other social parameters should remain peripheral to the strategic agenda. As good members of society, corporations are expected to pay taxes and to comply with regulations, when these are deemed necessary to solve or prevent ‘market failures’.

Complex nested health challenges, such as obesity and chronic diseases, differ from other health problems where precise ‘market failures’ can be easily singled out as causal agents (food safety or tobacco, for instance). In these latter cases, precise and strict regulations can be developed and reinforced to eradicate such toxic agents. The policy battle over obesity and chronic diseases is shaping up to resemble the tobacco policy battle of the 1990s and it bears pointing out that a key element in that battle was the scientific evidence that nicotine was addictive, a process not unlike the wired-in impulsive response to food and food cues in the environment. Governments are already using some of the policies that were used to combat smoking: taxation, prohibition and health warnings.

At the same time, food is not a toxic substance to eradicate because of the potential negative long-term impact of its excessive consumption, such as tobacco. It is the fuel that our species have learned to rely on for survival that has become too easily accessible through agricultural and industrial development. Food is also a hedonistic and symbolic object imbued with one’s personal, social and cultural identity. Health and other motives which underlie food choice are intrinsic components of the

value we attach to food and could therefore be carefully nurtured by family, community, media and other cultural leaders. They can also be sustainably capitalized upon by businesses in an economically sustainable manner in the development of a less caloric but equally pleasurable and profitable food supply. There is, therefore, a need for community-market transformation around the world, be it to restore the caloric balance in modern industrialized societies, such as Canada, USA and Europe, by adopting policy and broad governmental action plans, or to prevent the rise of obesity and chronic disease in emerging economies and middle-income countries, such as India and China.

In fact, bottom-up changes are happening. Local communities and civil societies around the world are more aware now than ever before of their capacity to shape such complex dynamics impacting the behaviours of individuals and families. Similarly, entrepreneurs and business executives in national and transnational corporations realize that developing health-promoting and sustainable products, services and programmes is not simply a matter of corporate social responsibility but can be a key driver of transformation, innovation and long-term strategic achievement.

There is a need to create and scale up sectoral and cross-sectoral policy approaches to diet-related health challenges to link appropriate and sufficient investment and incentives with transformation in communities, businesses, media, and markets – be these commodity, consumption or finance – to foster complex multilevel and cross-sector collaboration and innovation to change and sustain individual and family choices in a health-promoting direction. To this end, current surveillance and management information guiding public health and health care policy and practice must articulate a common mindset, metrics, methods and models with the social and economic processes and outcomes that contribute to the modern environment. The Brain-to-Society approach to chronic disease and epidemiology has the power to articulate a new science of the *hows* to lead, manage and govern such complexity for the 21st century, aligned with the limit and power of human biology.

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Uses and development of Geographic Information System (GIS) technology in epidemiological research

Mark Daniel

The use of Geographic Information System (GIS) technology in environmental and population health research is increasing *(1,2)*. The influence of different levels of environmental exposures, the nature of these exposures and individual-level socio-demographic, psychosocial and behavioural effects on public and population health outcomes are increasingly being studied using GIS *(3-6)*. The aims of the MEGAPHONE® GIS (Montreal Epidemiological and Geographic Analysis of Population Health Outcomes and Neighbourhood Effects) *(7)*, developed with the support of the Canada Foundation for Innovation, are to determine which environmental risk conditions are robustly related to health outcomes and to elucidate how these effects are expressed. The identification of environmental factors, both important and changeable, can provide an evidence base for policy interventions on services and resources needed for healthful living. Environmental intervention can enable healthful behaviour, e.g. provision of outlets for fresh fruit and vegetables or efficient public transportation can positively influence diet and active transport involving incidental physical activity. Other actions may include strategies to improve the quality of air and water or noise reduction.

Environmental risk conditions function at the level of communities or populations. They are the conditions of living and health-related resources and opportunities available to a population. They can be specific to a geographical area (e.g. the availability, accessibility and affordability of healthful food for a given community) or they can exert broad effects at the macro-social level (e.g. institutionalized racism or restricted economic opportunity) *(8)*. They are expressed as contextual measures of places (e.g. housing quality, social disorder or the availability and accessibility of goods and services) and as compositional measures of population attributes (e.g. aggregated educational attainment or income).

Relevance of environmental factors

It is a tenet of public health that environmental and lifestyle or behavioural factors are reciprocal in their relationships to each other and hence influence health indirectly and directly (Fig. 1). By this logic, the lifestyles and health status of populations cannot be understood or targeted for improvement without attention to environmental factors. The principle underlying the focus on environmental risk conditions is that the causes of individual cases are not the causes of incidence *(9)*. Causes of cases are individual risk factors whereas causes of sick populations (incidence) are environmental risk conditions. This can be shown by contrasting different populations in their distributions of risk factors and disease. Much epidemiological research has, however, implicitly or explicitly, attributed diseases for which there are known behavioural components to individual causes. This disregards that the population distribution of risk is inherently a function of environmental factors, including the norms, resources, opportunities and living conditions that define a population. A biological 'norm' or 'deviations' cannot be defined without reference to specific populations and their characteristics *(10)*.

Fig. 1: Environmental and behavioural-lifestyle factors are reciprocal in relation to clinical risk and disease outcome

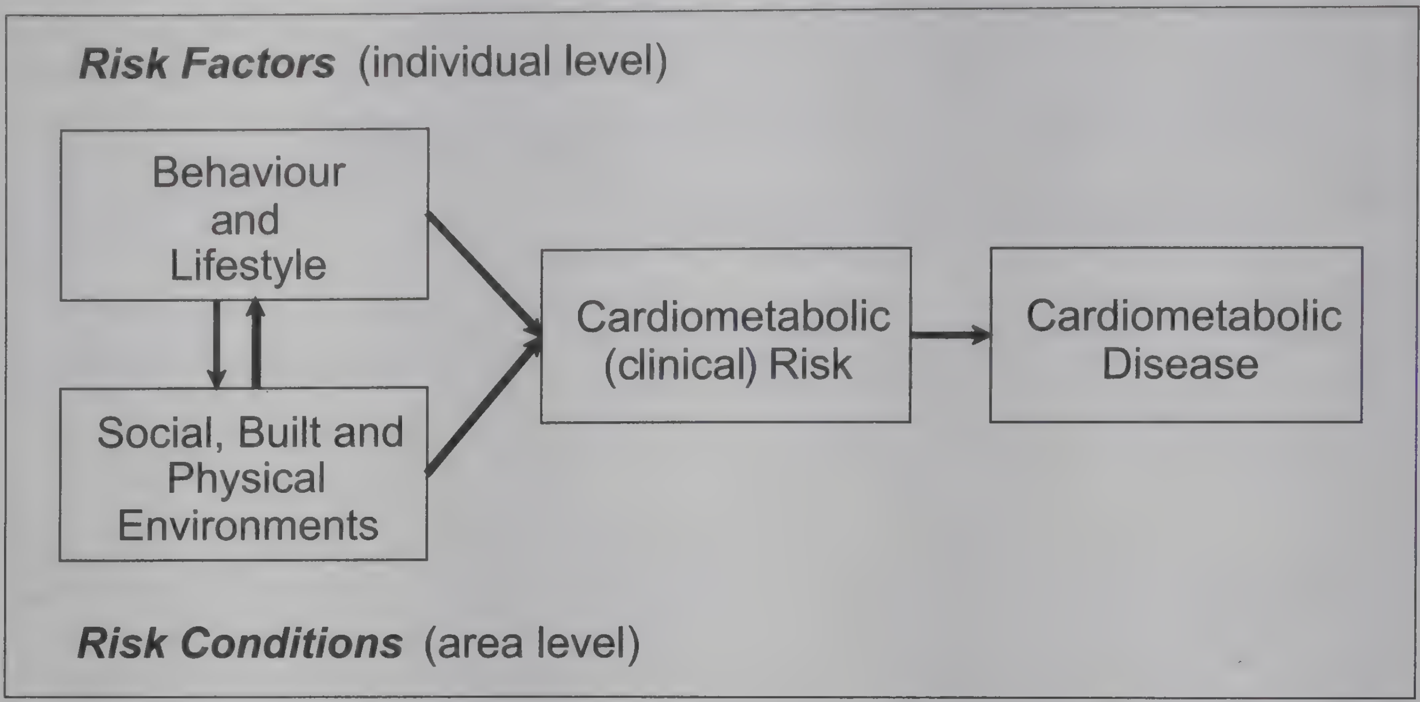


Fig. 2: Environmental risk conditions influence the distribution of individual risk factors

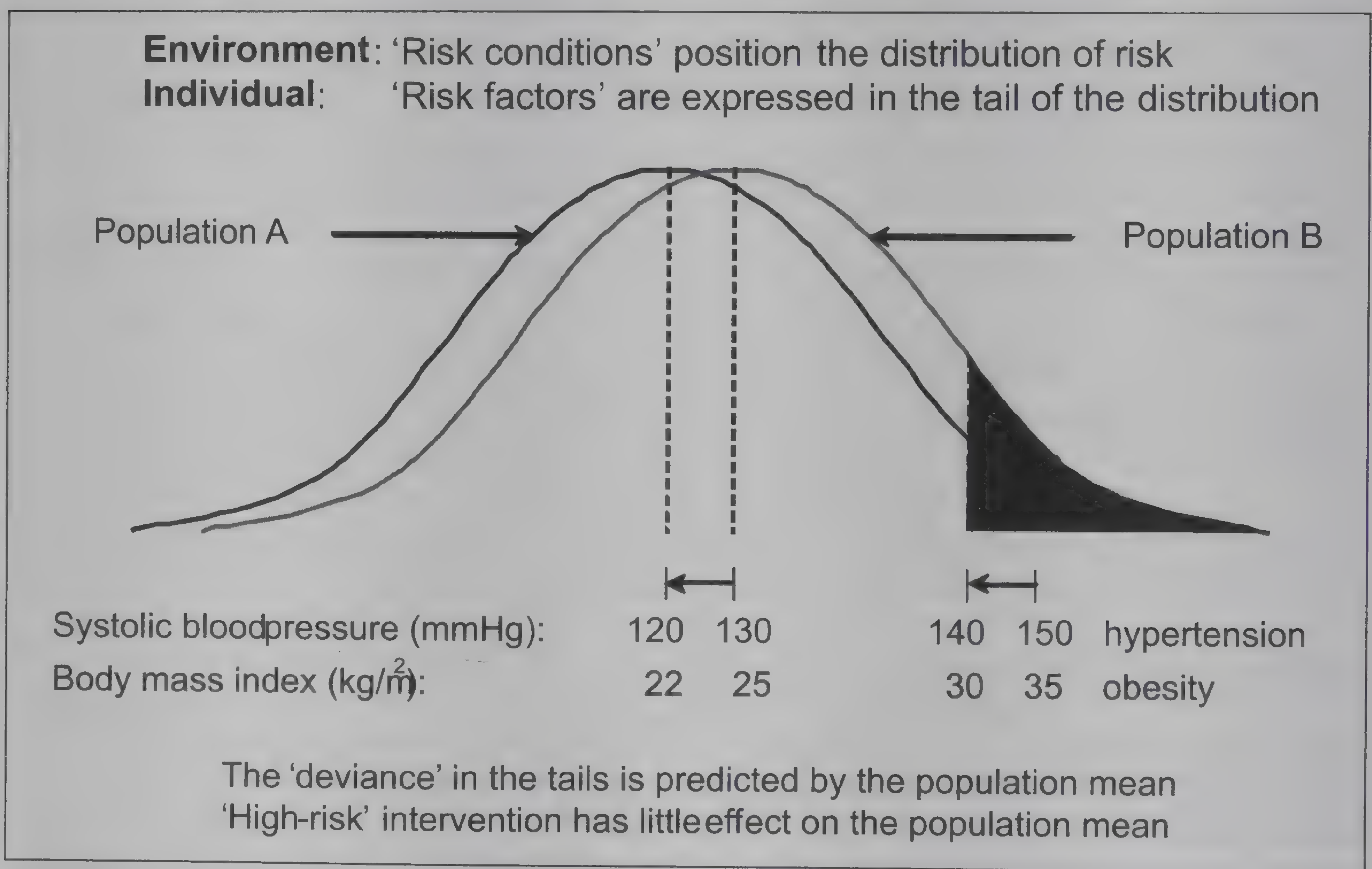


Fig. 2 shows two hypothetical populations: Population A with healthful mean body mass index (BMI) and systolic blood pressure (SBP), and Population B with these means at high, unhealthful levels. For each population the deviance or excess risk in the tails is predicted by the population mean. The level of absolute risk is greater for Population B than for Population A and, relative to high-risk cut-offs for Population A, Population B has proportionately more excess risk for both BMI and SBP. Within populations, the distributions of behavioural factors can largely account for the distributions of BMI and SBP, their means, and levels of absolute risk. What explains population differences in mean BMI and SBP and absolute risks? Population B will have a greater frequency of behavioural risk factors surely, but Populations A and B will also differ in environmental features that affect the distribution

of behavioural risk factors which, in turn, positions the population means for BMI and SBP. Hence, shifting distributions of BMI and SBP for Population B left, towards Population A, requires targeting environmental conditions which yield higher levels of behavioural factors related to BMI and SBP. Attention to at-risk individuals in the tail of the distribution is necessary but not sufficient to reduce overall risk. Other individuals will become at risk and there will remain the need for high-risk patient intervention so long as environmental factors that position the mean remain unchanged *(9)*.

Spatial epidemiology

Spatial epidemiology focuses on spatial variations in disease patterns in relation to variation in environmental risk conditions. The purpose is to identify disease causes and correlates by relating spatial disease patterns to geographical variation in environmental factors and population socioeconomic, demographic, psychosocial, behavioural and biological factors, for the purposes of prevention and control through policy and environmental actions. Whereas risk factors are properties of the *individual* that exacerbate an underlying vulnerability to ill health, risk conditions are subjective or objective properties of the social, built and physical *environments* that directly or indirectly increase an underlying vulnerability of individuals exposed to those places *(8)*. *Social environmental* factors include cultural identity, collective hopelessness, institutional racism, poverty, unemployment and crime; *built environmental* factors pertain to the physical form of communities as measured by land use, large- and small-scale built features including housing, food sources or recreational areas, and the *physical environment* includes attributes of soil, water, air, noise or temperature. All such factors can be studied using GIS.

With respect to Fig. 1, social and built environmental risk conditions can exert indirect effects on health by preliminary effects on behaviour. An example would be collective hopelessness or lack of recreational resources (swimming pools, paths or air-conditioned or heated buildings for exercise) being related to cardiometabolic disease via negative effects on behaviour *(11)*. Social and built environmental risk conditions may also have direct effects on cardiometabolic risk through biological responses to chronic stress (*12)*. Physical environmental factors are similarly directly associated with cardiometabolic risk; for example, cadmium ingested from local food sources or noise from traffic *(13,14)*. Indirect effects of physical factors are also possible where cold or heat may inhibit physical activity and thus may increase behavioural risk.

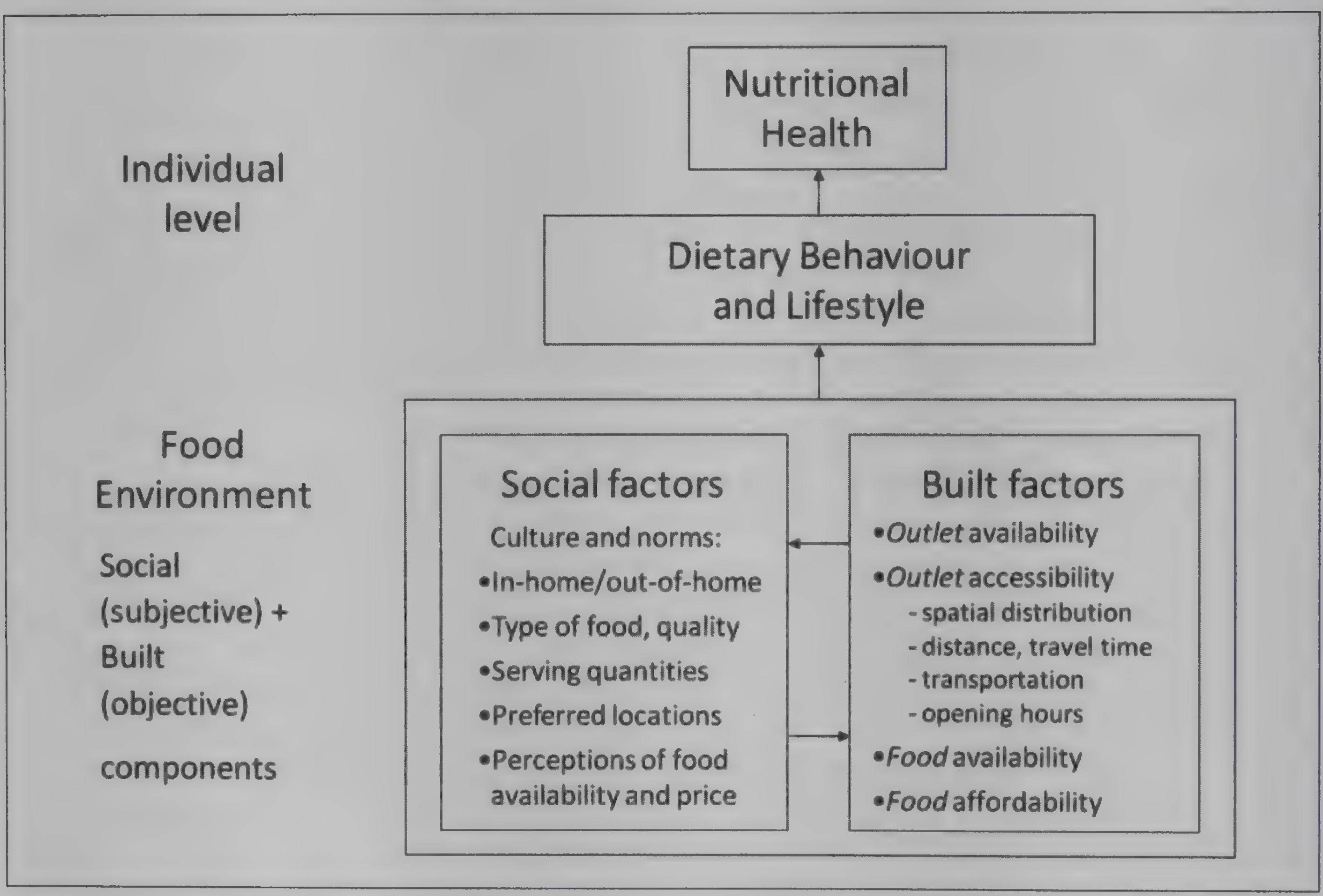
Outcomes beyond chronic disease are linked to environmental risk conditions. For example, in terms of the physical environment, the odds of pre-term birth and low birth weight babies are higher for mothers residing within 200 metres of a freeway (where nitrogen dioxide levels are highest) in Montreal *(15)* . This study was based on an analysis of nearly 100 000 births and adjusted for maternal education and both individual and area-level socioeconomic status (SES). In terms of the social environment, a separate analysis of the same dataset indicated that small-for-gestational-age births were inversely related to perceptions of neighbourhood security, with the lowest odds of small-for-gestational-age births being observed in neighbourhoods in which perceived security was greatest, even accounting for SES *(16)*. In terms of the built environment, an analysis of more than 30 000 cardiovascular deaths in the Montreal census metropolitan area indicated that fast-food restaurant density per km^2 was positively associated with cardiovascular mortality. This analysis accounted for 1200 fast-food restaurants across 845 census tracts. The relative risk of death from cardiovascular disease was 1.4 per each 10% increase in fast-food restaurant density, accounting for socio-demographic and SES variables *(17)*.

Coverage and nature of the MEGAPHONE® GIS

Montreal represents just a small geographical portion of the province of Québec, Canada. On the other hand, the Montreal census metropolitan area accounts for almost half of the provincial population

(3.4 million of the 7.2 million individuals overall). The most densely populated part of Montreal is Montreal Island, on which 1.8 million persons reside, slightly more than half of the 3.4 million persons included in the census metropolitan region. The MEGAPHONE® GIS includes some databases specific to the Island of Montreal with most databases covering the entire metropolitan area. Databases integrated within the GIS represent two sets of spatial structures: (i) context, specifically, the spatial structures of places – resources, opportunities, living conditions (built, physical and social features of environments); and (ii) composition, specifically the spatial structures of the resident populations and their features – socio-demographic, SES, behavioural factors and psychosocial status. Databases with primarily indirect measures are used to represent context and composition (government administrative data, e.g. census; commercial and public data on businesses and services; and surveys of residents in their perceptions of residential areas). Other databases provide direct measures of environments: satellite data on 'green space' (normalised difference vegetation index); and directly recorded field observations of neighbourhoods, with and without the use of global positioning systems. Direct observations systematically obtained in the field by trained researchers and surveys of resident perceptions are particularly relevant to developing countries where the spectrum of administrative, commercial and public sector data needed to understand context and composition may not be widely available.

Fig. 3: Components of the food environment

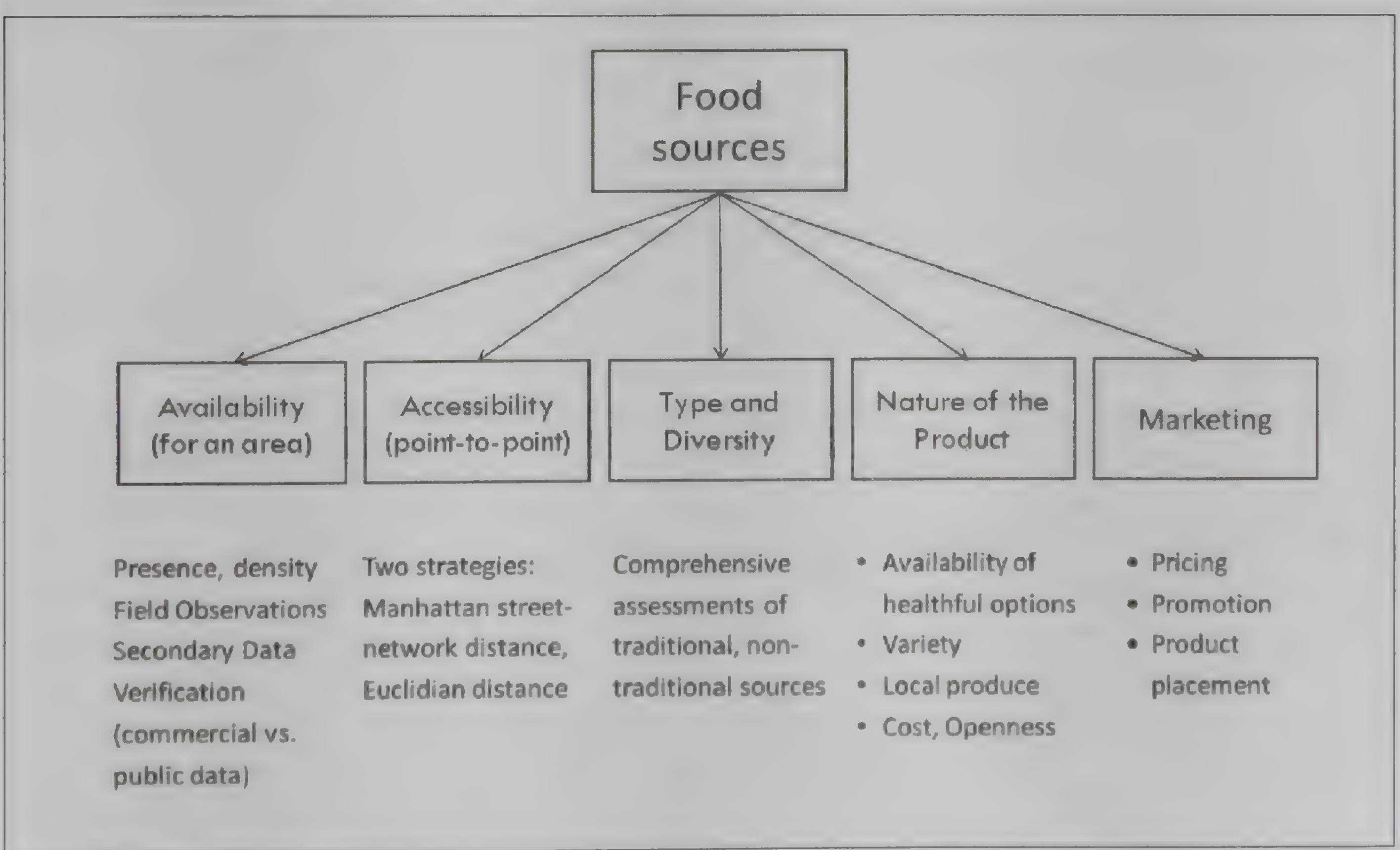


The food environment can provide a good example of the data needs and the role that can be played by GIS in support of these needs (Fig. 3). Here, individual-level measures of nutritional health and dietary behaviour can be obtained and evaluated in relation to relevant social and built environmental factors. Social and built factors function reciprocally to define the food environment by which diet and nutrition options are expressed for individuals. Regarding the built environment, GIS can measure food source availability in terms of the density of food outlets in a given area. One can also determine food outlet accessibility and the distance a person has to travel to get food. If the data are available,

one can assess the nature of the food that is available and the nature of the food that is affordable. The social environmental is relevant in terms of culture and norms regarding in-home or out-of-home consumption patterns, types and quality of foods consumed, serving quantities, preferred locations for obtaining food, and perceptions of food availability and pricing which may differ from the directly measured reality. Social factors like these and culture, more generally, are spatially distributed as are built environmental factors relating to food. Such geographical data are not generally captured by government data sets but can be prepared using spatially organized inventories of services or resources, residents perceptions and direct observations by researchers.

Spatial data can be characterized in different ways; for example, by using predefined administrative boundaries (e.g. census tracts) or using buffers of defined radii to scale spatial representations for each survey participant according to where they live, work or travel between residence and work, or all three *(18)*. It is often feasible and straightforward to perform multilevel modelling that considers food outlets and people as nested within census tracts or similar administrative units. But this approach has been criticized, in that administrative boundaries are artificial and typically lack a theoretical justification for use in representing meaningful social spaces. Buffer zones suffer this same limitation in the arbitrary specification of radii; however, buffer size can be allowed to vary according to some relevant environmental factor (e.g. population density) and buffers have the benefit of being centred on the location of individual residents. Given the data, GIS can be used to represent a broad spectrum of key dimensions of environments. Considering again the food environment, the spectrum of dimensions given in Fig. 4 can be captured by GIS where the use of indirect measures from administrative and commercial services data on the left end of the continuum (food availability and accessibility) transitions to more-or-less direct measures obtained from field research, on the right end of the continuum (nature of food products and marketing). A complete spatial representation of the food environment will thus involve a combination of indirect and direct measures.

Fig. 4: GIS can represent different dimensions of the food environment



The MEGAPHONE® GIS, specific to Montreal, compiles and integrates into a single relational data system a broad variety of different kinds of spatial information on human environments. In building this GIS the aims were to enable: (i) research on compositional and contextual factors relevant to population health status; (ii) surveillance of social, physical and built environmental characteristics as they evolve over time; (iii) multilevel, multisectoral analyses on a spectrum of environmental influences; and (iv) support for decision-making for programmes and policies to improve population health and quality of life. Categories of data include the physical and built environment, urban infrastructure, social environment and administrative health indicators.

Data themes and examples

Regarding the physical and built environment, satellite imagery allows for viewing of an entire area to extract information on vegetation (Normalised Difference Vegetation Index – NDVI), urban density and land use. NDVI is a numeric indicator of the density of vegetation, calculated from measures of visible and near-infrared sunlight reflected by plants, where darker green is signified by higher values (denser vegetation). Our analyses submitted for publication show for the Island of Montreal that the greenness of parks and park area are inversely associated with all-cause and mortality from chronic disease for individuals residing within 250 metres of parks even after accounting for powerful influences of SES. Satellite data also allow for derivation of essential information for characterising land as residential, commercial, industrial or institutional. We have also integrated built environmental data from direct observation of 250 street sections across 30 census tracts on the Island of Montreal. This involved measuring 150 contextual environmental characteristics of urban neighbourhoods with respect to urban form (e.g. street safety elements and parking), negative attributes (e.g. rubbish, crumbling masonry and graffiti) and positive attributes (e.g. maintained dwellings and sitting benches). Evaluators rated the condition of streets, public spaces, dwelling units and the presence/absence of specific features. A key consideration in direct observation is that raters must be well trained to achieve strong intra- and inter-rater reliability. The two raters responsible for collecting street section data were trained for four weeks. Inter- and intra-rater reliability was assessed using the kappa statistic and internal consistency was ascertained using Cronbach's alpha. Inter- and intra-rater reliability was excellent (>0.80) for items pertaining to urban form and substantial (>0.60) for domains on positive and negative characteristics. Internal consistency was acceptable (>0.70) for urban form and negative characteristics but not positive features *(19)*. This work demonstrates through assessment of psychometric properties the rigour of a tool to measure positive, negative and urban form characteristics for evaluating environmental factors relevant to population health status in a wide range of research contexts.

Other built environmental data incorporated into the MEGAPHONE® GIS include values for 416 161 properties representing 892 340 dwellings for which available information includes: land value, building value, construction year, building type and percentage of non-residential. A quarterly updated directory of all public and private sector businesses and services within the Montreal metropolitan area (n>119 000), geo-coded by address and postal code, provides further information. This directory uses Standard Industry Classification codes to identify a host of resources, for example, food – supermarkets, convenience stores, restaurants, fast food, bakeries; Physical activity – gyms, martial arts studios, pools, etc.; environmental risks – gas stations, refineries, etc.; and health, medical and social services. A validation study of this database determined that it was valid in terms of the likelihood that a listed establishment was present in the field (positive predictive value = 0.90) and that a food establishment present in the field was correctly listed in the database (sensitivity = 0.84) *(20)*. The businesses and services database has been applied to a range of research from analyses of fast-food outlet density and mortality *(17)* to evaluating HIV-related injection behaviour as a function of distance to and patterns of use of syringe supply programmes *(21)*.

Data on the metropolitan infrastructure include the complete educational institutions directory, more than 1 500 institutions classified by type; i.e. preschool, primary, secondary, vocational, college, university, etc., and by private versus public funding and official language of instruction (French or English). Using these data we have shown strong neighbourhood income gradients for schools in relation to food source exposures. Relative to the highest income-quartile schools, the odds of a fast-food outlet being located within 750 m of a low income - quartile school was 30.9 (95% CI=19.6, 48.9). These associations were reduced, but remained statistically significant in models accounting for commercial density *(22)*. The MEGAPHONE® GIS also includes the complete public transportation infrastructure (subway lines, commuter rail lines, bus routes and bus stops and the road network as used to evaluate adverse birth outcomes associated with residential proximity to freeways) *(15)*. A key source of infrastructure data is the Origin-Destination Survey from the Quebec Ministry of Transport. Undertaken every five years, this involves a telephone survey of individual movements made during a single day by residents of households within the Montréal metropolitan area (5% random sample; ~150 000 individuals per survey). Respondents provide data on: (i) household factors (location, size and vehicles); (ii) individual factors (sex, age and marital status); (iii) transport movements (origin, destination, time, duration and reason); (iv) transportation method (public, private or mixed) and mode (non-motorized or motorized); and (v) routing including use of bridges, tunnels and location of parking. We are using travel survey data to estimate environmental exposures for health survey participants for whom active (non-motorized) versus passive (motorized) transport measures can be derived and included in the analyses of health outcomes *(18)*.

In terms of the social environment the MEGAPHONE® GIS incorporates a wealth of census information (over 800 variables), crime statistics, voter participation in provincial and federal elections and data on municipal complaints. Analyses of these data have shown that census tract SES is positively related to the density of fruit and vegetable stores and inversely related to the density of fast-food outlets *(23)*. We have also shown using multilevel models that area-level unemployment is positively associated with BMI and cardiometabolic risk, accounting for education *(24)*. Current analyses are evaluating voting rates as a marker of collective engagement in relation to mortality rates and violent and non-violent crime in relation to mental health and health-related behaviour.

Fig. 5: Components of the MEGAPHONE® geographic information system

The MEGAPHONE® GIS being primarily a tool for representing health-related environmental exposures, the system incorporates only limited health outcomes data. Such data include the complete births and deaths files for the Montreal metropolitan region, coded at the level of the forward sortation area (first three digits of the six-digit postal code). Birth information includes the location of the birth, birth weight, length of pregnancy and mother's residential location, marital status, education and mother tongue. Death information includes the cause of death, age at death, place of death and deceased's marital status, home language and residential location. Where agreed upon, individual-level survey data from researchers collaborating in the use of MEGAPHONE® are also integrated. A schematic representation of the GIS is given in Fig. 5.

Value-added components of the MEGAPHONE® GIS

Environmental data are structured and stored in a relational system architecture, specifically, an open-source object-relational data-basing system (an early version of the system was transitioned from Microsoft Access to PostgreSQL). Metadata for files (e.g. data source, year, description, coverage) are compliant with international standards for metadata (OGC – Open Geospatial Consortium, FGDC – Federal Geographic Data Committee and ISO – International Organisation for Standardisation). Tools are also provided for automating the updating of files as new data become available, with automatic updating of the MEGAPHONE catalogue with new metadata.

Beyond data and metadata, MEGAPHONE® includes: (i) a catalogue with relational indicator classification typology, an executable application for navigating metadata and conceptual sorting of indicators; (ii) tracking software for compiling research project data (detailed information on projects, researchers and groups using MEGAPHONE® and their associated products); and (iii) sophisticated tools including a geodatabase (ArcGIS, ESRI) with geographical files containing geo-referenced spatial units – points, lines and polygons for geo-coding, upscaling or downscaling of data, and address locator software for geo-coding address or postal code data files. The ability of a GIS to account for different boundary units and scales of information, notably where boundaries do not correspond or align, and to move between layers of data, is exploited by MEGAPHONE®. Spatial analysis tools (buffers, convex hulls, segregation measures and macros for recalculation of data values for changed census boundaries) and spatial sensitive statistical methods (spatial autocorrelation, geographically weighted regression and centrographic analysis) are integrated for the derivation of spatially-informed, value-added data to extend beyond the raw data within the system.

Among the most important tools in MEGAPHONE® is its catalogue with a relational indicator classification typology for navigating metadata and conceptual sorting of indicators. This tool was originally developed as an adaptation of existing international indicator frameworks which were integrated and extended to enable relevance to disadvantaged Aboriginal communities in industrialized nations. This allows the focus of various national indicator classification systems to be extended to include elements relevant to *any* disadvantaged sub-population.

As described elsewhere*(25,26)*, indicator frameworks which inform the MEGAPHONE typology include those developed and used by major international (e.g. Organisation for Economic Co-operation and Development) and national organisations (e.g. Statistics New Zealand) and agencies for general population (e.g. Health Canada) and Indigenous population statistics (e.g. Australian Office for Aboriginal and Torres Strait Islander Health), and locally-oriented community-based indicator projects (e.g. Oregon Benchmarks) used to organise indicators. In total, 33 frameworks were studied. The "German System of Social Indicators" (German Social Science Infrastructure Services Social Indicators Department, 2004) was determined to be the most thorough and systematic and was used as the foundation of the MEGAPHONE® typology. The nomenclature used for hierarchical levels of the framework used in the "German System of Social Indicators" was adapted. The three levels of

organization that are used to categorize indicators are, from broadest to most specific: Subject Domain, Goal Dimension, Indicator Group (Fig. 6). Supplementation of the framework was completed with the addition and insertion of Subject Domains, Goal Dimensions and Indicator Groups from 14 other indicator frameworks.

Fig. 6: MEGAPHONE catalogue with relational indicator classification typology for navigating metadata and conceptual sorting of indicators

- Adaptation of "German System of Social Indicators" extending it to considerations relevant to marginalised communities

- All MEGAPHONE variables were classified in the Indicator Framework
  - Scientific and objective system for classification
  - Permits assessment of coverage of data included in MEGAPHONE
  - Allows identification of themes or data that are missing in MEGAPHONE

As the highest level in the framework, a "Subject Grouping" was adopted to correspond with the epidemiological framework that forms the basic differentiation of the MEGAPHONE® typology (Table). This has seven subject groupings that include Built and Natural Environment; Culture; Psychosocial; Social Organisations; Socio-demographic; Socio-economic; and Socio-political. Three other classification levels for indicators (Domain, Goal Dimension, Indicator Group) are not strictly nested in Subject Groupings. Rather, each Indicator Group (to which actual indicator measures are eventually coded) is assigned to one of the seven Subject Groupings as well as falling into a higher-order Goal Dimension, which itself falls into a higher- order Domain which is conceptually located beneath a Subject Grouping. This allows for sophisticated searching and establishing the explicit conceptual hierarchy by which an actual measured indicator is related to higher order constructs. The MEGAPHONE® framework thus includes 22 Domains, 101 Goal Dimensions and 112 Indicator Groups. Domains have between two and eight Goal Dimensions assigned to them. Indicator Groups are found in 31 Goal Dimensions (up to eight Indicator Groups per Goal Dimension), spanning across 12 Domains.

Table: MEGAPHONE indicator classification framework

7 thematic categories comprise "Subject Groupings"	22 Domains	
– Built and Natural Environment – Culture – Psycho-Social – Social Service Systems – Socio-Demographic – Socio-Economic – Socio-Political	– Background and History – Community Economic Resources – Community Well-Being – Consumption and Supply – Education – The Environment – Health – Housing – Income and Income Distribution – Indigenous Self-Government and Autonomy – Individual Well-Being	– The Labour Market and Working Conditions – Leisure and Media Consumption – Language – Participation – Population – Public Safety and Crime – Social Welfare – Socioeconomic Status and Subjective Class – Traditional Activities and Cultural Responsibilities – Transportation – Visibility and Representation

The MEGAPHONE® indicator framework thus provides a four-level structure by which indicators from diverse sources can be systematically classified and situated according to the concepts or issues they are designed to measure. The framework provides categories to accommodate conventional health and social indicators. It also includes sections that accommodate specific elements relevant to disadvantaged communities such as culture and language, identity and affiliation, historic events and policies, and community economic, social and political development. A comprehensive structured framework that incorporates these domains of key importance to disadvantaged communities and also contains ample categories for more conventional health and social indicators does not, to our knowledge, exist elsewhere.

The MEGAPHONE® GIS platform and indicator classification system for linking measures to constructs is transparent, systematic and inherently defensible. It explicitly depicts isomorphism between a measure and the hierarchical succession of constructs to which it relates conceptually. This allows for comparing the same sets of relationships between variables, even where different measures are used to represent a given construct.

Conclusion

The MEGAPHONE® GIS is a comprehensive, semi-automated, multidimensional Geographic Information System (GIS) (Daniel & Kestens, 2007) developed *(7)*, copyrighted and registered with ValCHUM (Valorisation CRÉA Inc, et VAL-CHUM s.e.c) via the Centre de recherche du Centre hospitalier de l'Université de Montréal. MEGAPHONE combines a comprehensive data system with a graphical user interface and has a proprietary utility as a relational infrastructure for the storage, management and analysis of geographical data. Funded by the Canada Foundation for Innovation, its purpose is to enable population health research and exposure surveillance across the Montreal Metropolitan region. MEGAPHONE combines a diverse array of spatial databases and analysis tools for representing social, built and physical environmental factors and analysing these in relation to health outcomes. MEGAPHONE contains the following geographical data spanning 1996-2010: (i) land use information on parks, industries and commerce, residential density, satellite imagery and information on vegetation index and heat islands, with physical barriers such as hydroelectric power lines, train tracks and highways; (ii) systematic social observations of the urban environment, namely, standardized direct ratings of a random selection of street blocks for 30 representative Census tracts;

(iii) presence of infrastructures, including the complete regional road network and mass transit system (metro/subway, train and bus); (iv) 120 000 public, private sector and institutional resources from a validated businesses and services directory; (v) education locations with complementary information on school SES-index; (vi) bimestrial crime data at the police district level; (vii) Origin-Destination surveys with detailed information on trips and daily movement patterns for 160 000 individuals within the Metropolitan region; (viii) complete municipal valuation role with data on property values and building units; (ix) voting patterns for federal and provincial elections; (x) a municipal database on the location of citizen complaints, and (xi) Census (1996, 2001, 2006) data for >800 census variables coded at tract - and dissemination - area levels. Geocoded morbidity, mortality and birth outcomes data are available in aggregated form, with individual-level data from collaborators and the MEGAPHONE team integrated into the GIS.

MEGAPHONE complies with international geospatial regulations and relies on leading software and technical advances in GIS and spatial analysis tools. It includes: a catalogue with relational indicator classification typology, an executable application for navigating metadata and sorting of indicators; tracking software for documenting research project data; and sophisticated tools such as geo-database with administrative limit files for geo-coding, upscaling or downscaling of data, and address-locator software for geo-coding address or postal code data files. Spatial analysis tools (buffers, convex hulls, segregation measures, macro for recalculation of data for changed census boundaries) and spatial sensitive statistical methods (spatial autocorrelation, geographically-weighted regression and centrographic analysis) are integrated for the derivation of spatially-informed, value-added data to extend beyond the raw data contained within the GIS. MEGAPHONE is currently being used by the Montréal Public Health Department (Direction de la santé publique, Régie régionale de Montréal-Centre) for surveillance of local social, built and physical environmental risk conditions, health risk factors and disease outcomes. In research, MEGAPHONE has been utilized thus far in collaborations with 24 peer-reviewed projects with grants funds totalling $14.2 million. With ongoing development and regular updating of data, the MEGAPHONE® GIS will remain a powerful tool for environmental, population and public health research. It has the potential to be used as a model for similar developments in other settings to support and enable international comparative research, particularly that supported by its relational indicator classification framework, to determine conceptual comparability of related measures.

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Parallel Session 5

HIV, TB and Malaria: framing policies and programmes in the science of epidemiology

Chairpersons: *Supachai Rerks-Ngarm*
Nani Nair

Session Coordinator: *Nani Nair*

Trends in tuberculosis – What is the evidence? – *Knut Lonnroth*

Anti-malarial drug resistance: A potential global emergency – *Charles Delacollete*

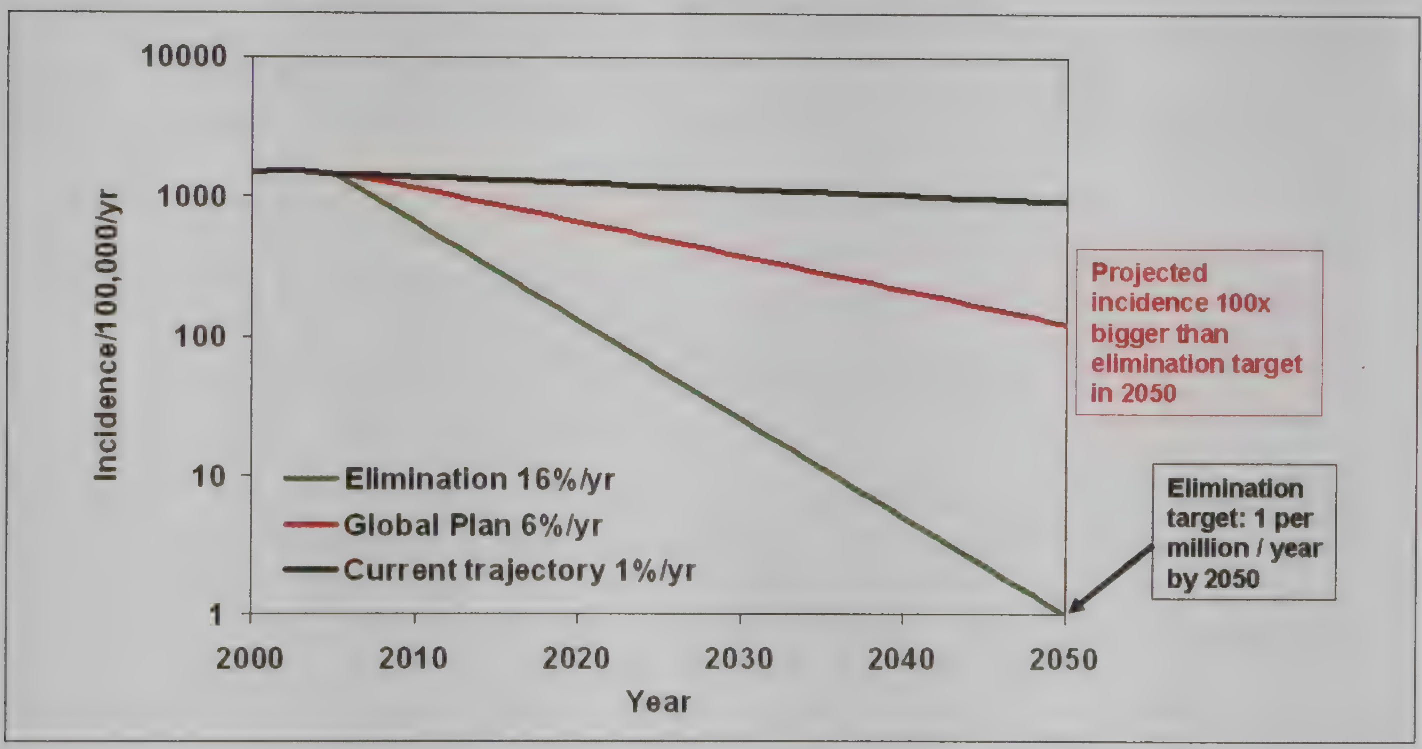
Towards universal access to HIV prevention and care – *Charlie Gilks*

Trends in tuberculosis: what is the evidence?*

Knut Lonnroth

The incidence of tuberculosis (TB) in the world had been on the increase until 2004. Since then, there has been a turnaround and now there is a slight decrease, probably less than 1% per year. If this trend extrapolates over the next 40 years, the level that will be reached by mid-century will only be slightly less than what it is today. In 2005, the Global Plan to Stop TB (2006-2015) was developed by WHO and its partners. This strategy includes a lot of different components and elements, but, essentially, it tries to ensure universal access to good-quality TB diagnosis and treatment. If this plan is successful, the TB transmission can be cut successfully and incidence brought down to a level which is one tenth of what it is today. That would be a huge achievement. However, much more is needed to reach the TB elimination target for 2050, which is one case per a million population. It is an ambitious target. Globally, more than15% reduction in TB incidence is needed every year to achieve it (Fig. 1).

Fig. 1: Three scenarios for the future trend in tuberculosis incidence rate



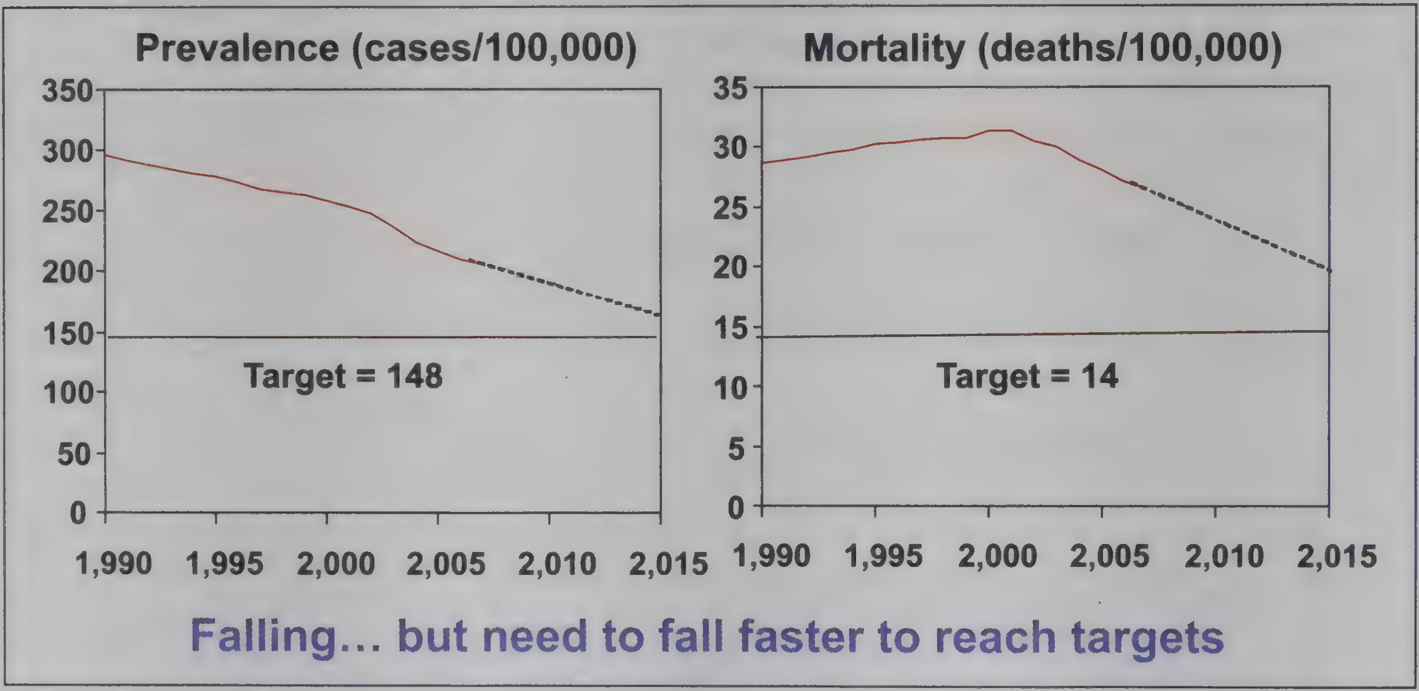
Even though good data are not available, the estimates indicate that around one third of the world's population is already infected with TB. There are therefore billions of people who would continue to generate cases in the next several decades even if the transmission is cut down to zero. To sped up decline in incidence, more needs to be done about prevention as well. BCG vaccination is good for preventing severe forms of childhood TB, but not preventing TB inl. We need to support the development and implementation of better technologies, vaccines and preventive treatments, but there

* Prepared from the video transcript, subsequently edited by the speaker

is also a need to start thinking about prevention in terms of addressing more effectively the TB risk factors and the more upstream social determinants of TB.

The prevalence and mortality of TB are going down globally but these may not be going down fast enough to reach the targets set in the Millennium Development Goals (MDGs), which is to halve TB prevalence and death rate by 2015 (Fig. 2). In four out of the six WHO regions, including South-East Asia, reductions will most likely be enough to meet the targets. The global incidence of TB shows that there has been an increase until recently and then a flattening off and a small decline in the last few years. Regional trends show that Africa experienced more than a doubling off of TB incidence in the 1990s, which was mainly due to the HIV epidemic. Europe is the other region that witnessed an increase at much lower levels, but still there was more than 50% increase in the TB incidence. It was more due to socioeconomic upheavals in the Region than anything else. All other regions experienced a slow decline of TB incidence. The South-East Asia Region is still at a high level and is decreasing very slowly despite the fact that programmes in this Region have done really well, i.e. increasing case detection and achieving good cure rates. Therefore, it is a surprise not to see an acceleration in the decline of TB incidence in this Region.

Fig.2: TB prevalence and mortality trends



Priority actions that are required in the future include ensuring access to good quality diagnosis and treatment. One needs to talk about 100% case detection, not only for the most infectious pulmonary TB but also for all types of TB, including multidrug- resistant TB. It is not only because of the concern about the epidemiological impact but also because of the right of the people for care in order to reduce suffering and avert death and mitigate socioeconomic consequences of the disease. Therefore, TB care should be treated at par with other national health programmes. More investment is needed in national TB programmes beyond the basics to encompass high coverage of quality diagnosis and treatment. All sectors of the health care system, including the private sector, communities and NGOs, need to be engaged in building a stronger health system. TB control programmes need to try to contribute to the strengthening of the health systems rather than just wait for that to happen. Improved diagnostics and new drugs are needed to ensure good diagnosis and treatment of TB.

Recent findings from TB prevalence surveys indicate tough challenges with regard to getting TB case detection to increase and to have early case detection in order to cut transmission more effectively. Three surveys from Viet Nam, Cambodia and Zambia have shown similar findings -- between 15% and 35% of bacilli-confirmed cases of infectious TB did not report any symptoms. They did not have

symptoms or did not perceive themselves being ill. Even among those who had symptoms, many did not have the classical symptoms which qualify them to be "TB suspects". About 50%-60% cases did not report cough for more than 2-3 weeks, which is the classical definition of TB symptoms. For a long time, passive case-finding has been relying on people when they experience severe symptoms and go to the health services where the health worker screens them for cough; and if they have cough for more than 2–3 weeks a diagnostic test is done. If 30% cases do not experience any symptoms, and if 50%-60% have fewer symptoms, then with the current screening criteria, a lot of cases will be missed. There is a need to be more active in identifying TB cases early.

India has recently reduced the screening criteria from three-week cough to two-week cough. That is one step, but maybe one needs to go even below that in order to catch people early, particularly some sub-categories of people who are living with HIV and other high risk groups. In this context, there is already a WHO policy which is being scaled up in many countries to screen actively people with HIV. The next one is to screen TB contacts which is also in the policy, but, unfortunately, it is happening only in a few of the high-burden TB countries.

Other risk groups is a new field. Are there other risk groups that also need to be screened? Some mapping has been done within WHO over the past two years to look at what risk groups are most important (Fig. 3). Important risk factors for progression to active TB disease include: HIV,undernutrition, smoking, air pollution, diabetes and alcohol abuse. Figure 3 provides estimated relative risk, average prevalence in TB high-burden countries, and the population attributable risk for each factor. This analysis provides insights into some risk groups that may be eligible for TB screening. Other groups, such as migrants, prisoners, slum dwellers, and other at-risk population groups may also be targeted. This analysis also sends a message about prevention. If one could reduce or eliminate these risk factors, proportional reduction in TB incidence can take place. TB control, therefore, depends on the control of both HIV and other risk factors. This will require scaling up of interventions to manage and prevent these risk factors, i.e. through public health programmes, but also by addressing the social determinants behind these risk factors. The population-attributable risk might

Fig.3: Selected risk factors for progression from TB infection to disease

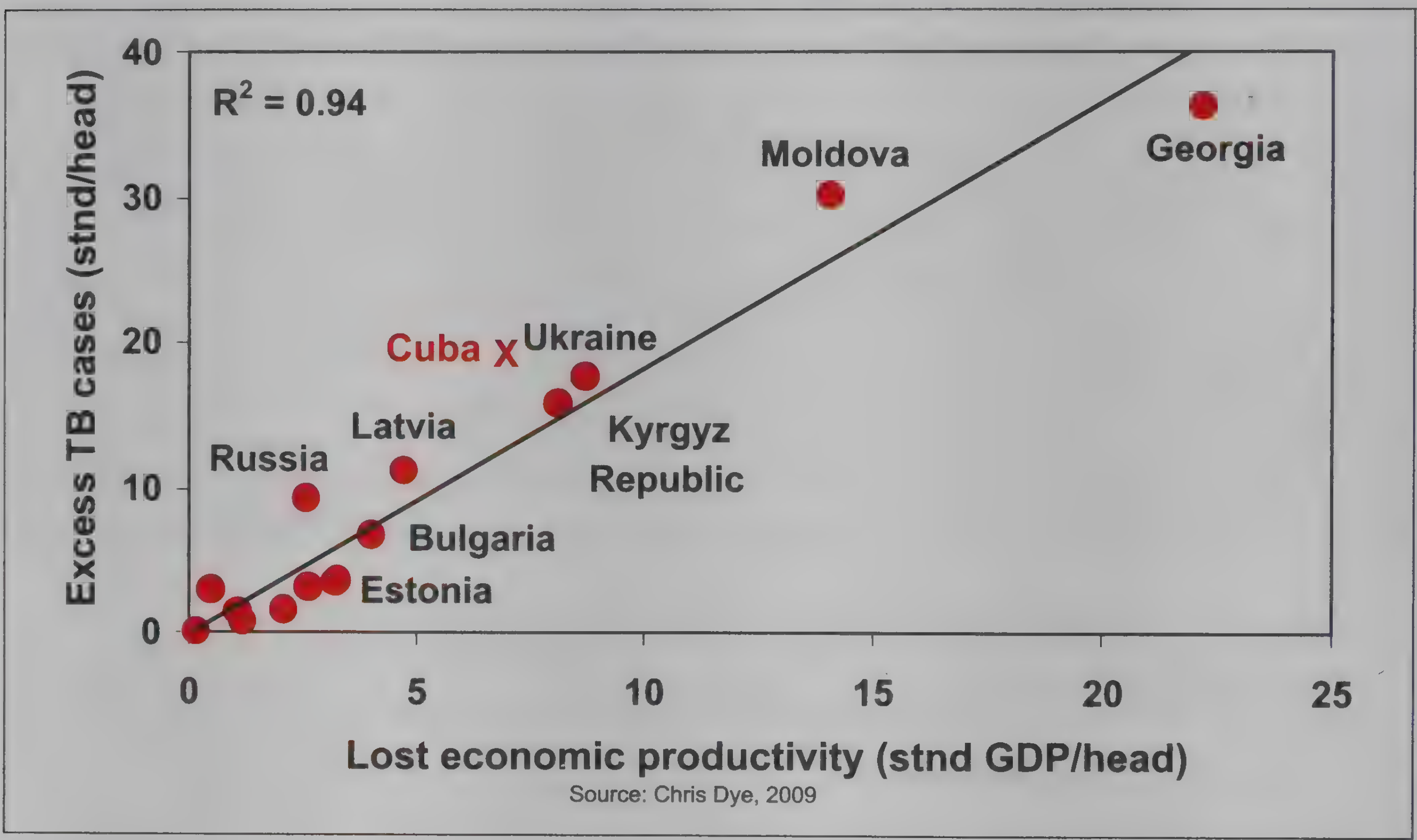
	Relative risk for active TB disease	Weighted prevalence (22 HBCs)	Population Attributable Fraction
HIV infection	20.6/26.7*	1.1%	19%
Malnutrition	3.2**	16.5%	27%
Diabetes	3.1	3.4%	6%
Alcohol use (>40g / d)	2.9	7.9%	13%
Active smoking	2.6	18.2%	23%
Indoor Air Pollution	1.5	71.1%	26%

Sources: Lönnroth K, Raviglione M. Global Epidemiology of Tuberculosis: Prospects for Control. Semin Respir Crit Care Med 2008; 29: 481-491. *Updated data in GTR 2009. RR=26.7 used for countries with HIV <1%. **Updated data from Lönnroth et al. A consistent log-linear relationship between tuberculosis incidence and body-mass index. Submitted, 2009

increase further for alcohol and diabetes in the future since the prevalance for both are ion the rise in many developing countries.

Addressing risk factors and social determinants is a common agenda of MDGs and beyond. It has been known for a long time that TB is a disease of poverty. Lower socioeconomic status is associated with a higher risk of TB because people in this groups have higher exposure to risk factors, i.e., more crowding, less food security, and probably more smoking and drinking and HIV as well. TB prevention can happen by addressing the risk factors or by addressing the underlying social and economic conditions. In western Europe, a decline in TB incidence occurred during the past two centuries before the availability of any curative treatment. There was a 95% reduction in England and Wales before the 1950s when the first TB drugs were made available. The reduction was mostly because of socioeconomic improvements, improved nutrition and improved living conditions.

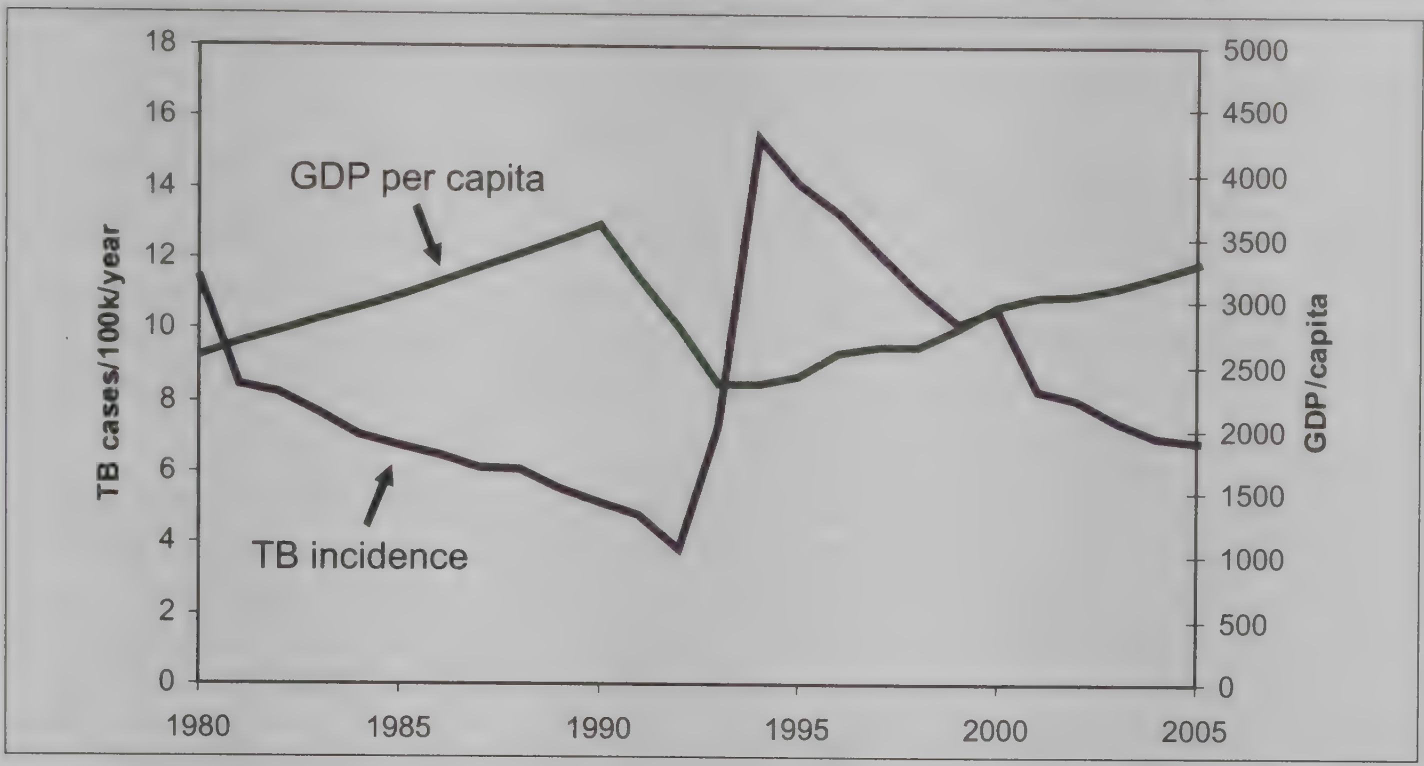
Fig. 4: TB and economic recession, 1990s - Excess morbidity driven by a process common to 15 Central & Eastern European countries



Conversely, economic crisis increases TB incidence. For example, countries in Eastern Europe and Central Asia show a linear relationship between the level of economic shock and increase in TB in the 1990s (Fig. 4). A dramatic and quick effect of the economic downturn happened in these countries. A similar effect was seen in Cuba. When the Soviet Union crashed, the economy in Cuba also crashed. At that time, Cuba was moving towards TB elimination, down to about four per 100 000 people. But once the economic crisis hit in the 1990s (there was a drop in GDP per capita by a third), there was a rapid surge in the TB incidence, which doubled within a time span of only 2-3 years. Then, there was slowly economic recovery and TB incidence also reduced slowly, but it did not come back to the levels of the late 1980s (Fig. 5). This can be explained by many different factors or pathways. One potential pathway is the impact via the food insecurity that hit Cuba over a couple of years after the economic shock. If fat consumption is regressed on the TB incidence curve, one gets a perfect fit, almost all of the variation in TB incidence goes with the fat consumption, and that, in turn, is almost 100% correlated with the economic shock. This illustrates how TB incidence is very sensitive to economic and social changes at community level and that these kinds of changes can happen quickly.

Fig. 5: TB crisis in Cuba

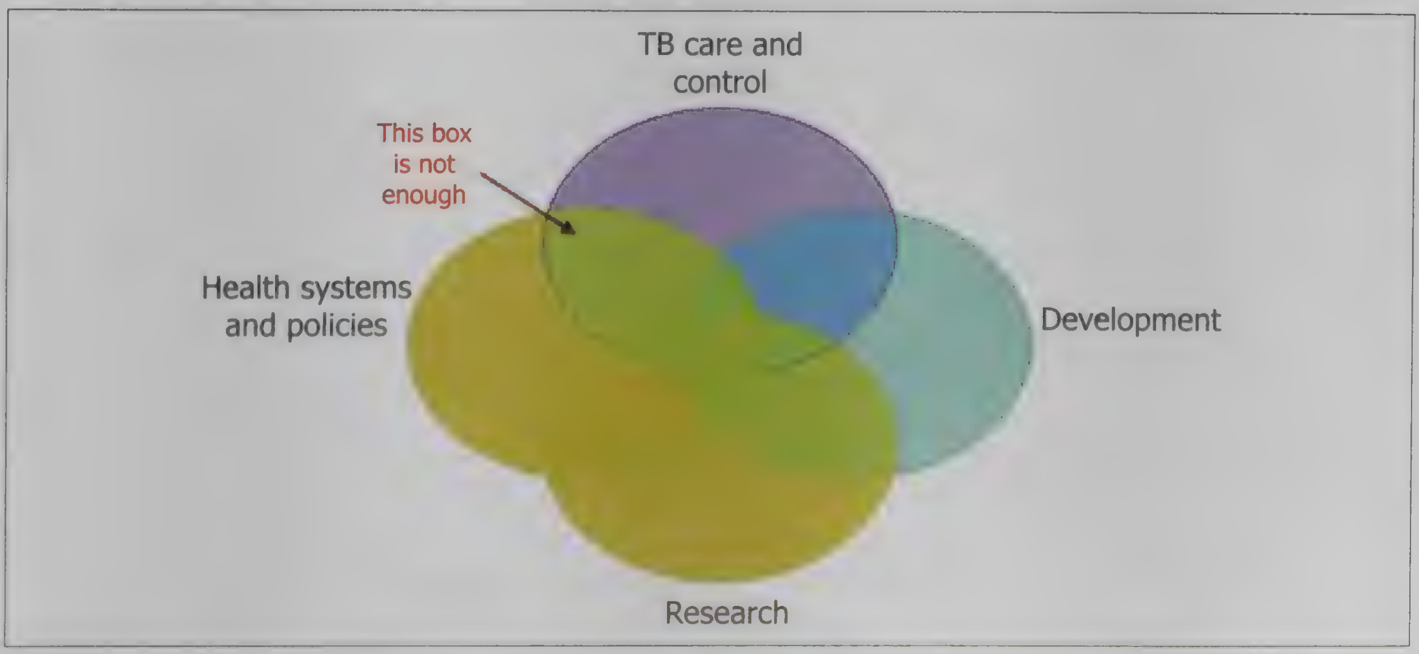
Cuba: upturn in TB incidence linked to economic shock, partly mediated by nutritional crisis



Having highlighted the need for prevention through actions outside the health sector, it is important to emphasize the need for sustained support to the basic TB control functions of national TB programmes, including all the elements of DOTS and WHO's Stop TB Strategy. All elements of the strategy needs to be scaled up, but one also needs to go beyond that (Figure 6). First of all, there is a need for research, not only basic research but also operational research, to support programme implementation. Then, one needs health systems and policies. TB control programmes need to help the agenda of strengthening health systems. Finally, acknowledging that TB incidence is one of the best development indicators, one needs to look at the development agenda as well. TB control can positively contribute to development.

To conclude, much more needs to be done than what is being done now and there is a need to support research to develop innovative and effective interventions that will help bring the TB burden down in the future.

Figure 6: Innovative action for TB con: Moving beyond the "TB box"



Antimalarial drug resistance: a potential global emergency

Charles Delacollette

Malaria resistance to the globally-promoted artemisinin-based combination therapies (ACTs), which is emerging in the Mekong region, is a potential global emergency. Epidemiological data provided by Mekong countries to WHO show that malaria and many other communicable diseases are more common on international borders *(1)*. Effectively controlling diseases and other threats on international borders remains a challenge for many reasons, one of them being that some of these countries are not at peace with each other. A decline in the therapeutic efficacy of all antimalaria drugs has been observed in this region starting with chloroquine, then sulfadoxine-pyrimethamine (SP), mefloquine, and now ACTs *(2)*. Prediction-efficacy monitoring is being carried out for informing policy-makers. There is a constant need to identify alternative therapies to existing ones which are seriously failing.

This year is the sixtieth anniversary of intensified malaria control in Thailand. In this country, the antimalarial drug policy has changed several times – from chloroquine to SP to quinine and tetracycline to mefloquine, and, from 1995 to date, to ACT. Based on growing evidence that the currently-recommended ACT is failing in Thailand, a change to more efficient and preferably co-formulated therapies has to be considered *(3)*.

There is recent evidence from molecular markers that parasite strains resistant to chloroquine and SP spread from Asia to Africa. The fear is that the same scenario could happen with *falciparum* strains showing growing tolerance to artemisinins. First cases showing resistance to chloroquine occurred in1957 in Asia and Latin America. Molecular biologists have identified genetic markers of resistance to chloroquine and SP in Africa similar to those in Asia while looking back at blood samples kept in laboratories all over the world. They were able to trace the last 60-years' history of malaria parasite genes everywhere in the world *(4,5)*. What has happened with chloroquine and SP could similarly happen with antimalarial medicines that national programmes are currently promoting in the Mekong region. That is why WHO has set up its regional sentinel site surveillance network to monitor the therapeutic efficacy of antimalarial drugs promoted as first-line drugs. As a matter of principle, all policy-makers should formulate a policy based on strong evidence. The first thing that has to be done is to convince researchers and national programme managers that they have to use the same methodology to measure resistance. That is why sites have been set up where the therapeutic efficacy of any drug, preferably by using similar techniques, can be carried out. Technical support, including training and funds, are provided to help them implement the so-called WHO standardized *in vivo* protocol *(6)*. This is not so simple, at least for those working at the programmatic decision level, who are not necessarily researchers.

One of the challenges of the WHO protocol is that the follow-up of each patient has to be at least for 28 days because partner drugs being assessed are long-acting drugs, and sometimes till 42 days or even 63 days depending on the drug to be tested, from the onset of the treatment. Results from microscopy have to be double-checked for their accuracy since the measurement of the efficacy is mainly based on asexual malaria parasites being present and accurately counted in blood before and during treatment *(7)*. The availability and use of quality drugs in the Mekong region is also a big challenge. For example, there was a recent survey which found that a significant proportion of antimalarial and other drugs being used in the region were either counterfeit or sub-standard, triggering international multisectoral actions *(8)*. It means that medicines under evaluation must be of excellent quality matching the recognized international standards. The data generated have also to be managed properly. There are different ways of computerising, analysing and reporting of results. Researchers usually display their results in many different formats, sometimes rendering further comparisons and conclusions difficult and complex to interpret. All research papers which are part of programmatic activities should ideally go to peer review committees before being published. This process is sometimes delaying the publication of research findings for years.

For the time being, a multi-country response to address *falciparum* resistance to ACTs is being implemented on the Cambodia-Thailand border. In the past, with chloroquine and SP, there was no or limited response to the unacceptably increasing failure rate of those drugs. Supporting networks for monitoring resistance is fine but what about the response? WHO is facilitating national and international experts to meet each other to reconcile contradicting opinions to discuss what should be done, how to make it happen and how to influence policy-makers in the region and globally *(9,10)*. What is contributing to making a difference in building evidence is the systematic use of the same agreed-upon methodology by researchers across countries and across continents. This remains a big challenge since most of principal research investigators are not actually following standardized research operational procedures, delaying further consolidation of evidence to convince policy-makers on strategic orientation changes.

In the Mekong region, there are many sites which have been decided by principal investigators, usually 3 to 4 per country, including China. These sites are supposed to implement the same protocol everywhere. Antimalarial drugs tested are the recommended first-line drugs in the Mekong region, which are either co-formulated artemisinin and dihydroartemisinin in China and Viet Nam, co-packaged artemisinin and mefloquine promoted in Thailand and Cambodia, or co-formulated artemether and lumefantrine in Lao PDR. Other efficacious combinations such as co-formulated artesunate and pyronaridine are expected to be marketed and monitored from 2011 onwards.

The therapeutic failure rates (%) of all ACTs are available and the disappearance of clinical symptoms and parasites are measured at regular intervals. The data are cross-checked to ensure their quality in such a way that when presented to scientists and policy-makers by principal investigators, they are not further challenged *(11)*. From the evidence gathered on increasing therapeutic failure, WHO is facilitating national decision-makers to shift to alternative drugs which, in their national programme, are bound to be the best ones across the region. It is for the first time this year – 2010 - that all countries in the Mekong region are promoting the use of artemisinin-based combination therapies which was not the case before. It is one of the results of international community, the Global Fund, and also WHO and its partners' efforts to make sure that all countries promote quality ACTs through public and private sector providers.

Artemisinin combinations that are based on artemisinin discovered in China are impacting on the parasites from the merozoites to the schizonts. These are very powerful since these target all the 48-hour cycle of parasites maturation in red cells, whereas quinine only attacks the last 24-hour cycle. It has some importance when we look at the efficacy of artemisinins. One of the most interesting data

generated from more than 3000 patients investigated during the last 10 years on whom the efficacy of the drugs has been systematically measured is the rapidity (clearance time) with which the parasites disappear from the blood. If blood smears are taken everyday from day 0 onwards, parasites usually disappear at least after 72 hours. It means the drug under evaluation is performing very well. Year by year, there is an increasing proportion of patients showing persisting *falciparum* parasites after 72 hours, meaning on day 3, and even day 4 and day 5. This observation was a warning that the parasite clearance time is increasing over time, which is something unusual, and which needs to be closely monitored and investigated *(12)*. Thus, it is clear that the drug is no longer acting as it should. This critical finding has triggered additional survey and studies by the international community.

Subsequent studies made it clear that even at 2000-km distance there are differences between the parasites. The parasite clearance times on the Cambodian side and on the Myanmar side as well as between the western part of Thailand and the western part of Cambodia differ significantly *(13)*. Policy-makers, researchers and programme managers are considering why it is happening and what to do next. There is a difference between different sites; the parasite clearance time should be between 24 and 48 hours, but in some sites, more than three days are needed to clear all parasites with an artemisinin-based combination. The situation is making experts think that something wrong is happening in that part of the world which could affect other countries as well if potential genetically-modified parasites are brought in different locations. A similar situation has been observed in one site in the southern part of Viet Nam where the clinical response is 85%, whereas it should be more than 90%. In Myanmar, a comparison of results between different sites shows that the therapeutic efficacy response remains acceptable except in one location in the south-eastern part where the proportion of patients with parasites on day 3 is up to 18% compared to less than 5% in other sites. These findings give some idea that something unusual is happening in specific locations. In western Thailand and in the southern part of the province of Yunnan, China, bordering Myanmar, there are sites with a more than 10% therapeutic failure rate after 28 days. This is above the 10% threshold recommended by WHO for countries in the region to shift to another more effective combination.

However, locations where the proportion of therapeutic failure rate is documented as the highest remain on the Cambodia-Thailand border. This is where the situation is considered as the worst and where containment operations have to be intensified. Highly sophisticated surveys carried out by international researchers have confirmed such worrisome results from in vivo studies confirming the Cambodia-Thailand border as the epicentre of *falciparum* resistance to artemisinins in the world *(13,14,15)*. Other similar sites have been found last year on the Myanmar-Thai border, in the southern part of Yunnan and on the southern Viet Nam-Cambodia border. Studies are currently being performed in those locations to confirm the presence of additional hotspots of artemisinin resistance in the Mekong region [WHO reports under finalization, 2010].

Since 2007-08, a bi-country containment project has been in operation which involves containment activities on the border between China and Myanmar.

This would involve collaboration between two countries where WHO will act as the facilitator. Cambodia and Thailand will also be engaged in a similar operation, especially in provinces in western Cambodia and eastern Thailand. This ambitious cross-border project aims to contain, and even eliminate, all suspected resistant parasites. This is a project of global interest which is employing both regional and global approaches to monitor resistance and mount a supranational response. The global monitoring is going to go beyond the Mekong region to India, Bangladesh, Indonesia, Vanuatu, Papua New Guinea, Solomon Islands and other continents like Africa.

The multicountry response has been successful in getting funds initially from the Bill and Melinda Gates Foundation, and subsequently from the Global Fund, in addition to domestic funding. In the hot

spot Zone 1, the parasites are to be eliminated, in Zone 2 around Zone 1, they are to be contained, and in Zone 3, control operations are to be intensified.

Many experts have raised the issue of migration and large-scale mobility of people within and across countries *(16)*. For example, in the eastern part of Thailand, many workers in local factories and farms are from Myanmar in addition to a large proportion coming from Cambodia, either on long-term or seasonal basis. People are moving across the region legally or illegally, especially to Thailand, which attracts workers from the Mekong region due to its dynamic productivity market. Those immigrants could be carriers of infectious diseases such as TB, malaria and HIV. A majority of them are very difficult to monitor due to their illegal status. Looking carefully at the migration patterns and national laws on immigration is a very important aspect of public health programmes in order to effectively control communicable diseases within and across countries *(16)*.

One of the major technical problems to address artemisinin resistance would be to replace artemisinin drugs by another completely different drug to minimize pressure on the parasites. The co-formulated atovaquone-proguanil, which is mainly promoted as a chemoprophylactic drug for travellers to endemic countries, has been proposed exceptionally as first-line drug under strict supervision in three hot-spot districts in Thailand and to cure *falciparum* cases identified through mass screening operations in hot-spot provinces in Cambodia. Experts are worried about the rapid resistance possibly occurring due to one single-point mutation with that non-artemisinin drug if made available through the unregulated private sector widely prevalent in Cambodia. After more than one year of operation, the project has started to show an impact on the *falciparum* parasites. Malaria deaths and morbidity are drastically declining to close to zero in the hot-spot Zone 1, both in Thailand and Cambodia. Such promising results have to be confirmed and maintained. The resistance containment project in all its technical and programmatic components is continuously challenging national control programmes, implementing partners, scientists engaged in basic and operational research and ultimately the concerned governments. Concerted joint efforts by all partners, researchers and programmatic experts, coupled with increased collaboration between regional governments agencies, will hopefully succeed in eliminating any threatening parasites.

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Towards universal access to HIV prevention and care

Charles Gilks

Globally, over 33 million people were estimated to be living with HIV at the end of 2008. HIV is a preventable disease. It is also very easily treatable but is not yet a curable infection. The global estimates of HIV cases are lower than those of any other infectious or chronic disease. The reasons for this are twofold: first, there is an extremely accurate serological test which is low-cost, very simple, highly sensitive and specific; and, second, many countries routinely survey antenatal women for HIV infection. Moreover, many countries are doing good-quality household biological and behavioural surveys, which is even a more sensitive way to derive population-based numbers of people living with HIV infection.

It was estimated in 2008 that about three million new cases of HIV infection had occurred in the world. There is no accurate way to know the number of new infections; however, incident cases can be relatively easily estimated from the prevalent adolescent cases. Two thirds of the global burden of the disease is in sub-Saharan Africa. In Asia, it is about 10%, and, of these, India accounts for the majority or about 50%. At one stage, HIV was reckoned to be an epidemic which was out of control in India, but now there is no evidence of increase but actually it is on the decline. The number of HIV cases has been declining from an estimated 2.5 million in 2002 to about 2.3 million now. Numerically, India as a country has the third largest number of people living with HIV. It is a big country with a large population but its prevalence rates are quite low. The decline in prevalence is a little bit faster because one of the issues that have made the interpretation difficult is the dramatic increase in the population size. There are some secular trends also which are driving down the prevalence, which is not all due to successful HIV interventions.

HIV is an eminently preventable infection; however, one could say that the prevention programmes are not doing particularly well even after 25 years of intense efforts and a significant evidence base of what works and what does not. Over 7000 new infections occur every day and nearly 97% of these infections are occurring in low- and middle-income countries. The rich countries are pushing forward to achieve universal access to the prevention component of a comprehensive package. This is most evidenced with vertical transmission: in North America, Europe and Australia, HIV infection transmitted from pregnant mother to infant has almost entirely been eliminated. However, still 1200 new infections occur every day in children globally. There is a growing feminization of the epidemic. Now there is gender parity in the number of new adult infections globally. Increasingly, infections are being seen in young people, adolescents and young adults who are traditionally quite difficult targets for effective public health interventions.

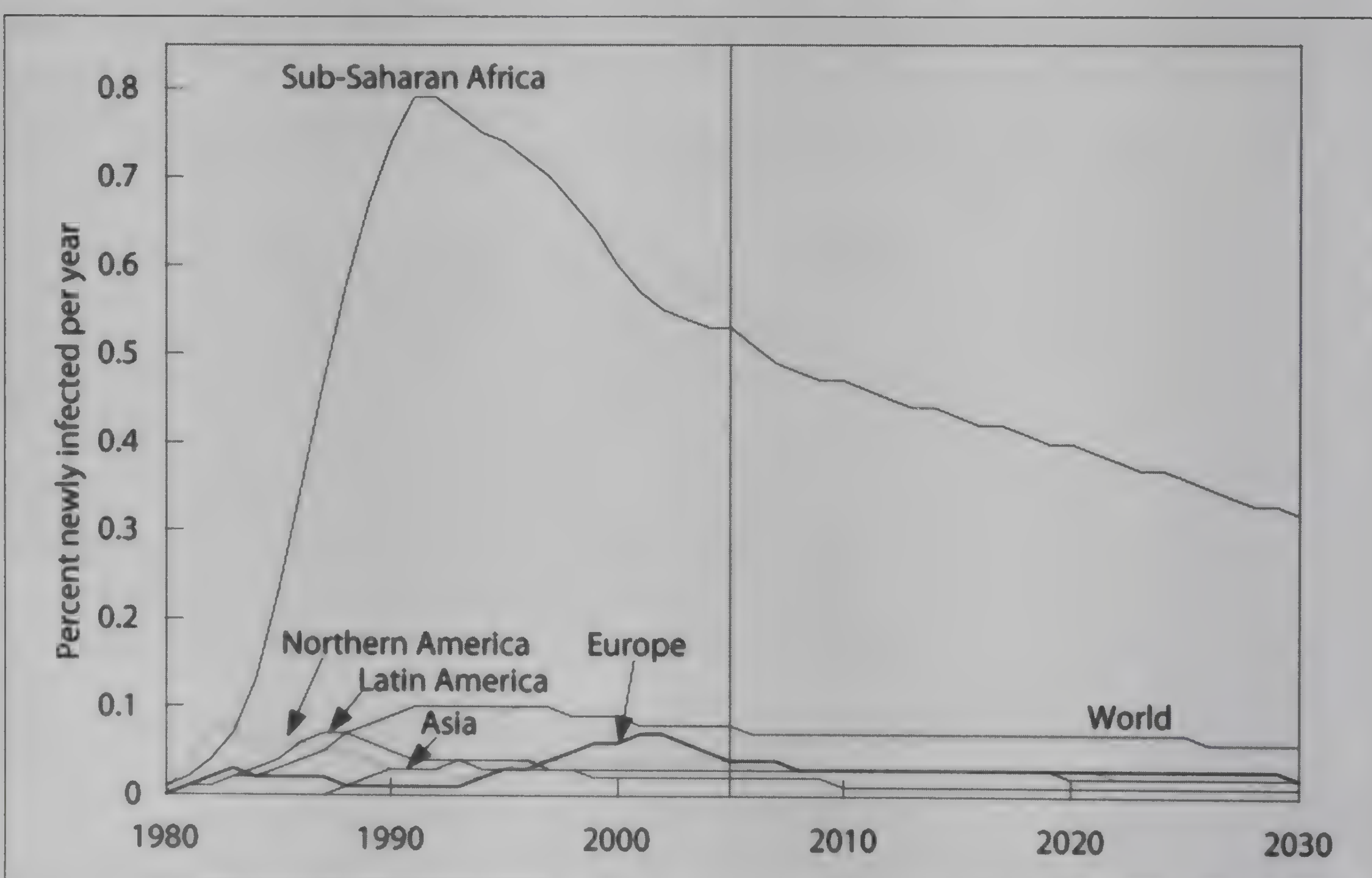
Untreated HIV infection is usually fatal but now highly effective antiretroviral therapy (ART) is available and accessible. Despite this, about two million people die of HIV every year, with the majority in sub-Saharan Africa. The large number of deaths is a big challenge for a comprehensive set of packages for HIV at a national or regional level. However, because of better access to combination ART, deaths are lower than it used to be a couple of years ago. Programmes are doing better in

terms of accessing treatment than prevention. In terms of prevention, by analogy, with making ART more effective by combining active drugs in combination ART, there is a movement towards combination prevention. Learning from the combination of treatment with prevention in TB and malaria programmes, it is clear now that the packages of prevention interventions, which are known to work, need to be effectively implemented to reduce the number of new infections.

The entry point to both prevention and care and treatment is voluntary testing and counselling of the individual about his or her HIV status. Of course, knowing whether infected or uninfected is a very important piece of information to the individual to base their prevention interventions on or to access current treatment. For preventable interventions at community level, products like condoms or clean needles and syringes for intravenous drug users (IDUs) are needed and behavioural changes need to be promoted and supported. Some of the structural constraints which limit individuals, particularly in marginalized groups, from accessing preventive services because of stigma and discrimination or punitive legal laws need to be overcome. (The recent decision of the Delhi High Court striking down Article 377 against sex between men is a forward step.) Finally, medical interventions are needed, e.g. antiretroviral drugs to prevent mother-to-child transmission (MTCT) or offering opioid substitution therapy for intravenous drug users. Combination prevention has actually been responsible for quite an impressive decline in the incidence of AIDS but more can and must be done.

The incidence rates of HIV, particularly in sub-Saharan Africa, peaked in the 1990s. Although, often, there has been criticism of not having effective measures of prevention, it is clear that there has been a significant decline in several regions of the world. Importantly for Asia, there is an early peak and decline in both India and China. It is clear that secular trends are there (Fig. 1). While HIV incidence rates have gone down quite significantly in many parts of the world, they are appearing to stabilize. Rapid decline, which was probably due to somewhat more easy interventions on targeted groups, particularly in Africa, has not been sustained, and there appears to be a flattening out. That is one of the reasons why it is more of AIDS being endemic rather than HIV being epidemic.

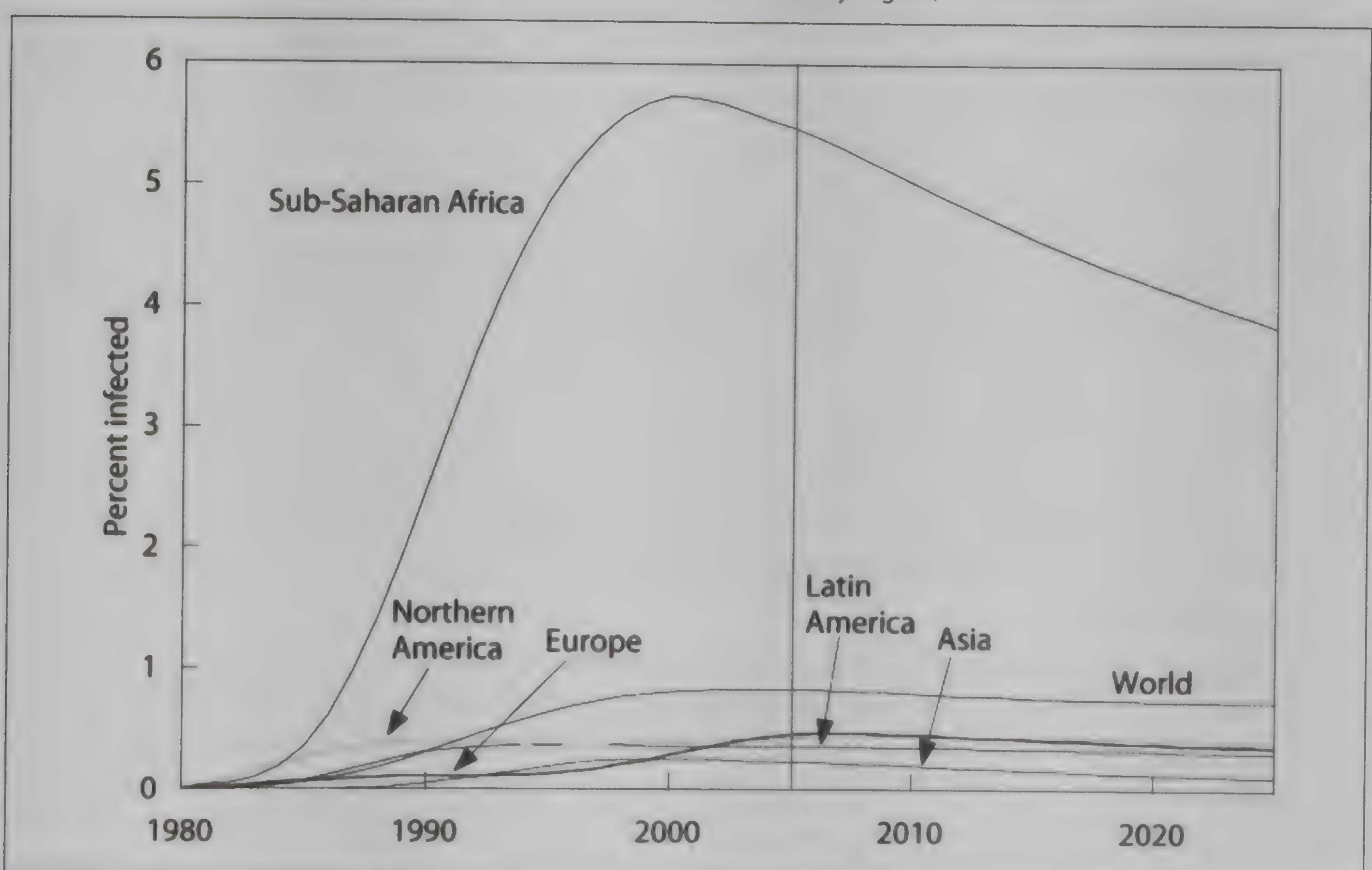
Fig. 1: Trends in HIV incidence rates by region, 1980 onwards



Source: Bongaarts J et al. Development and Population Review. 2008;34:199-224

In terms of global scale up of treatment, at the start, 200 000 people were accessing ART in low- and middle-income countries, with more than 100 000 individuals in just one country, Brazil. Interestingly, this was the first country in that group that had made a political commitment to scale up ART coverage to all those who needed it. This was the inspiration for the WHO "3 by 5" campaign which had the goal of having three million people on ART by the end of 2005. A highly ambitious time-limited target – three million people on ART – was achieved at the end of 2007. By the end of 2008, four million people were on ART, and now the number of individuals with HIV who have accessed ART is in excess of five million. This is staggering progress – especially given the challenges that ART scale up faced at the beginning of the millennium. At one stage it was said that in lower-middle-income countries, people were not going to be able to take drugs regularly because they could not tell the time and that these drugs were extremely expensive and would never be affordable. The average treatment cost was about US$ 5000 per person per year, and as high as US$12 000 in high-income countries. The very successful scale up of treatment is also reflected in the prevalence curves of HIV (Fig. 2). Because of successful ART meaning more survival, the HIV prevalence has fallen far less rapidly than what it would have been without ART. One of the issues linked to the success of HIV treatment is keeping people alive who really need quite a long-term commitment to treatment for 10 to 15 years. Sustaining the commitment to treatment as well as to prevention as a package of comprehensive response is a political issue.

Fig. 2: Trends in HIV prevalence rates in adults by region, 1980 onwards



Source: Bongaarts J et al, 2008

Successful scale up of the prevention and treatment interventions is going on in India. The third phase of the National AIDS Control Programme (NACP-3), which is taking India's national response to scale, is a massive example of target-driven public health. The idea has been to rapidly get a series of standardized care support and treatment interventions based on the particular risk and HIV profile of a district or community. Standardized approaches and packages, with uniform costing and components, facilitate national roll-out to districts where they are needed and that also means they can be rolled out very quickly.

At the national level, there is a committee to maintain two thirds spending in favour of prevention and a maximum of one third for treatment. This may be difficult to sustain because of the success of the treatment programme and if budgets are not globally increased for the fourth NACP. The prevention issues have been targeted for the high-risk groups. Targeted interventions deliver services appropriate for HIV prevention for sex workers, usually females but also male sex workers in some centres, for intravenous drug users (IDUs), and for men who have sex with men (MSM) and transgender communities. The targeted interventions are aimed at the populations most at risk because India, like the rest of Asia, has a concentrated epidemic rather than the generalized heterosexual epidemic in Africa; and the bridging populations which facilitate spread from the most-at-risk groups to the general population. This includes female partners of MSM and IDUs (largely a male issue), long-distance truck drivers and migrant labourers.

Integrated counselling and testing services, through which people are encouraged to go in for free HIV testing and standard package of basic services, are provided, and then prevention of mother-to-child transmission is implemented. In the current programme the first-line alternative and the second-line antiretrovirals are provided free of cost. Testing and counselling and health facilities are made available when they are sick. Strong HIV and TB cross-linkages are very important to foster and deliver, given the dynamics of the interplay between HIV and TB.

Services were prioritized for those districts in India which have the highest burden of HIV. Over 600 districts have been divided into four categories: category 'A' is the highest where HIV is more than 1% in antenatal clinics; there are over 150 districts in category 'A'. Many of the targeted interventions are focused on category 'A' districts because it is there where the majority of the cases are. Then there are category 'B' districts, where the prevalence is higher in the high-risk groups. Category 'C' and 'D' districts are low-prevalence or unknown-prevalence districts. In the mid-term review of NACP-3 it was clear that this prevalence profile is not sufficiently accurate to target prevention interventions because it only shows where prevalent cases are but does not address the risk and vulnerability of communities to acquiring HIV. There is going to be a new categorization of districts which is to incorporate risk and vulnerability to HIV, which will be finalized soon. In particular, this will focus on migrant labourers in their source districts from where they originate and ultimately return; some will have acquired HIV despite active intervention (targeted intervention –TI) in the destination districts and will then be at risk of transmission to their regular partners. It is important to note that migrancy involves both men and women and interventions focusing on discordant couples need to recognize that it can be either the male or the female partner who is positive and discordant. This will increase rather than decrease the number of category 'A' and category 'B' districts, which is going to be a challenge to the budget.

The targeted interventions have rapidly spread across India (Fig. 3). In 1995, HIV was first recognized in Tamil Nadu where a series of interventions were started for sex workers. They were not called TIs then, but can be called TIs now because they were indeed interventions targeted specifically at female sex workers. By 2009, TIs had reached a saturation point. It is interesting to note that there has been a change; some of those who were receiving TI services in 2005 did not get them in 2009. After a careful follow-up by national authorities, the TIs that did not achieve the targets were stopped. There is an active roll-out of TIs with constant monitoring by the National AIDS Control Organisation (NACO).

One of the products of which the delivery has been scaled up is condom, particularly the socially-marketed product, because the aim is to encourage users to spend a small amount on its purchase as there is then a likelihood that it will be used. Over 137 million free condoms have been distributed, mainly for family planning and HIV prevention. The number of needles and syringes that has been distributed as part of TIs focusing on intravenous drug users has not been in desired quantities.

Fig. 3: Targeted interventions in India by district

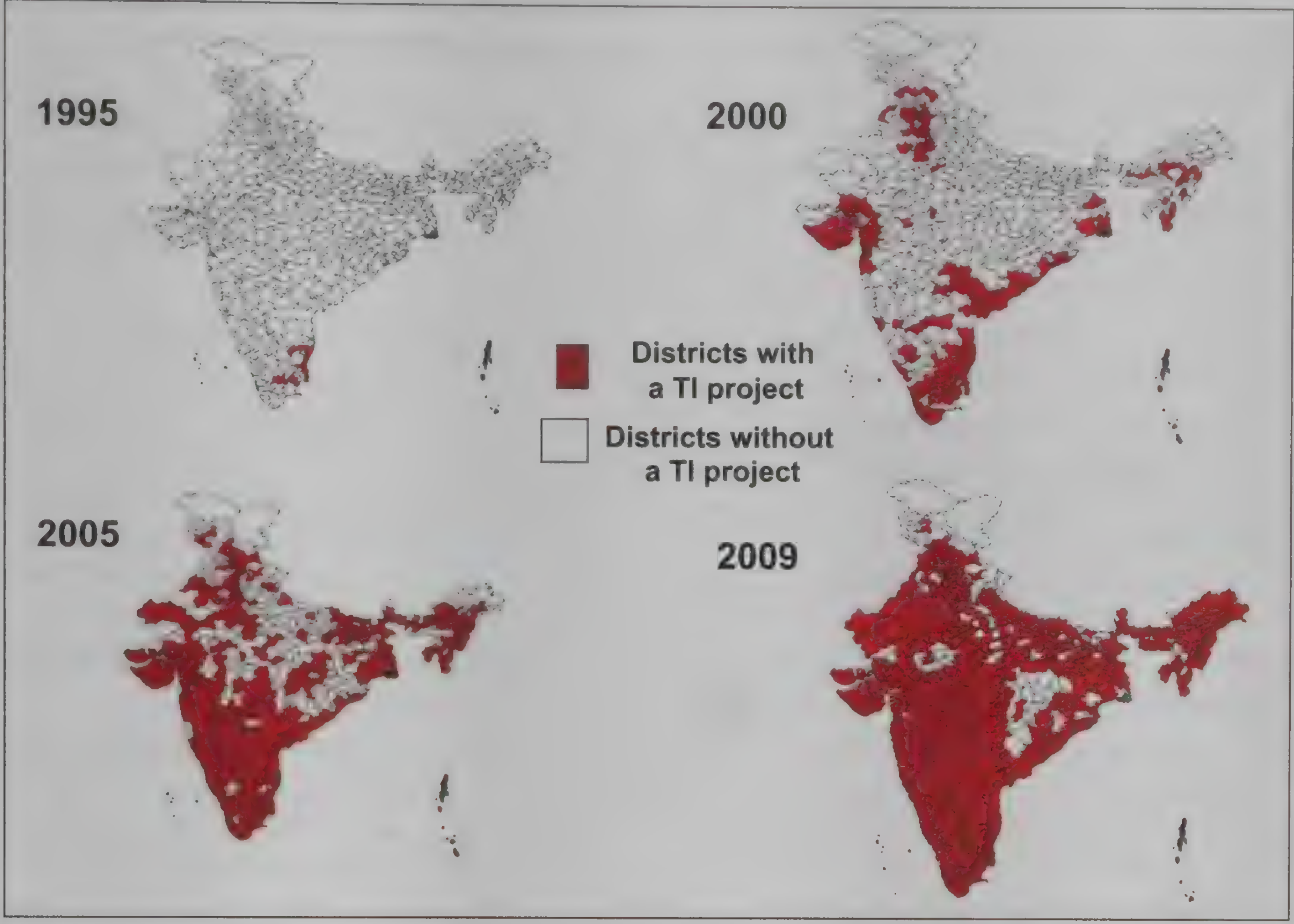
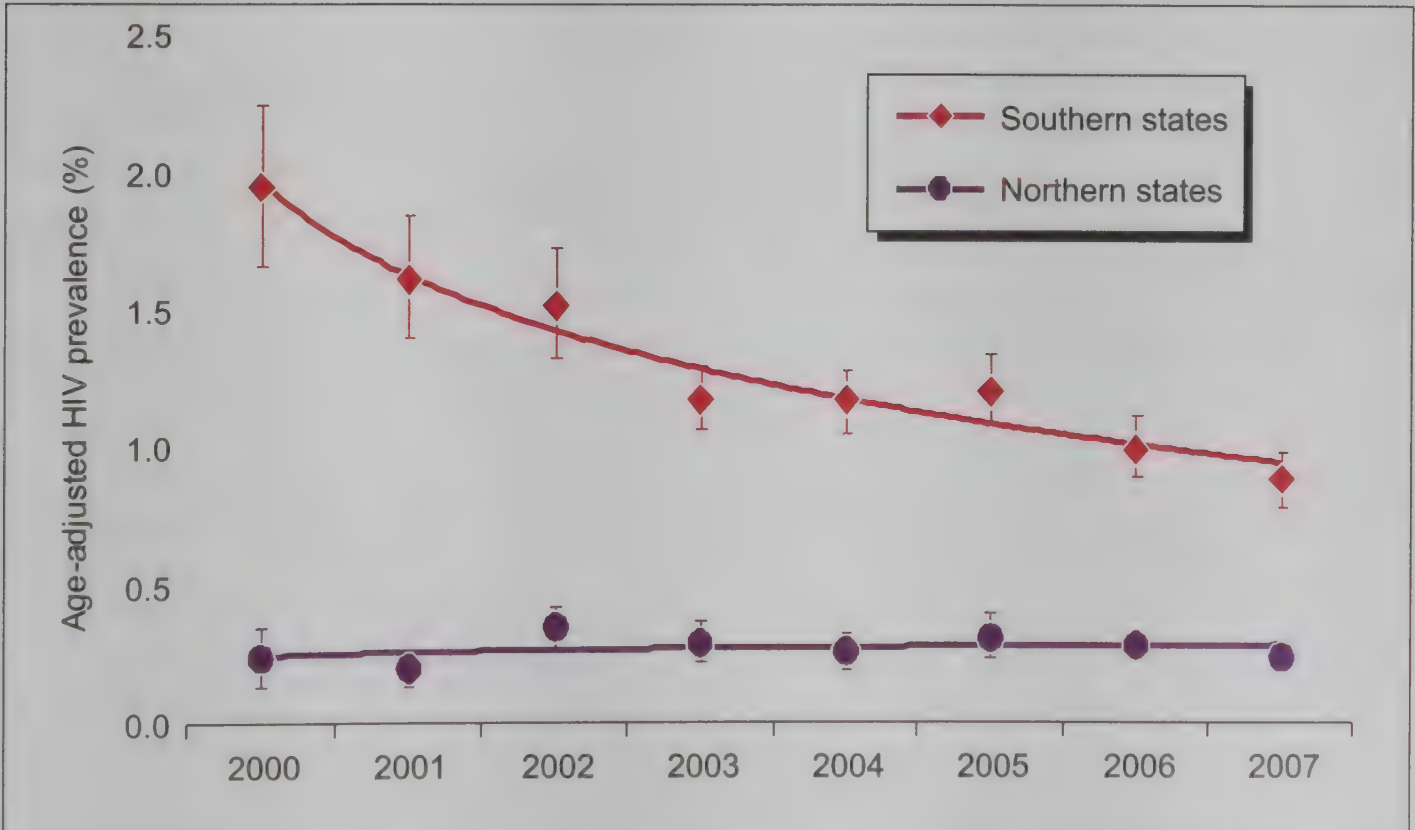


Fig. 4: Age-adjusted HIV prevalence among antenatal attendees aged15–24 years from 2000 to 2007 in high-prevalence states (Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu) and northern states of India



Logarithmic trend line; test for trend by logistic regression, with age adjustment to the entire study population,
n = 202 254 for the south, n = 221 588 for the north.

Source: Arora et al. Lancet. 2008; 372(9635):289-90.

One of the characteristics of the HIV epidemic is that four states carry a much higher burden of the disease. These states are Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu. Over the last seven years there has been a substantial decline in the antenatal prevalence of HIV (Fig. 4). It was the same story when the epidemic declined in Uganda. What were the real drivers of this decline? Without adequate baseline data it is not easy to be 100 per cent sure but it is clear that a lot of the decline has been due to successful targeted interventions, largely among female sex workers, and, more recently, in men who have sex with men. States in the north have a low level of infection, but unlike the southern states, the prevalence is not falling. There is low prevalence in northern states but they do have over a million people living with HIV.

As far as the feminization of the epidemic is concerned, at this moment, nearly half of the adults living with HIV in India are women. In many low- and middle-income countries, there has been a poor delivery of effective prevention of mother- or parent- to-child transmission (PPTCT). These countries are doing quite poorly in terms of coverage of even a basic component of PPTCT. India is reckoned to have 20% to 40% coverage but most of that is in the form of a single-dose nevirapine, which is regarded as a suboptimal intervention. In the cascade, there is a drop off of pregnant women who are tested, get the result, and get even an ART and have appropriate follow-up. However, India has recently adopted the new global guidelines on more effective PPTCT-combination ARV regimens, either for prophylaxis or treatment, which will become the national policy. The government is committed to an ambitious scale up and will soon adopt the goal of virtual elimination of infant HIV by 2015.

India has taken off with its treatment scale up, both in terms of the number of ARV clinics which provide ART to over 200 patients. Over 700 000 HIV-positive people are registered for pre-ART care. This is an important number because the focus always tends to be on ARV therapy, whereas pre-ART services, including cotrimoxazole preventive therapy, are as important as ART for preserving life and improving health. Over 300 000 people started ARV treatment but only 220 000 remained (Fig. 5). Survival rather than the number starting the treatment is the real measure of the success of the programme. To remain alive, people have to regularly take their first-line treatment, and when that fails, then the much more expensive second-line treatment is to be given. Indian figures are comparable to sub-Saharan Africa in terms of loss to follow-up, deaths and transfers, but the country could certainly do better in this sphere (Fig. 6). It is clearly one of the issues in the national programme to rapidly scale up and at the same time improve the intensity and quality of the interventions.

Fig. 5: Status of ART scaleup in India, April 2009

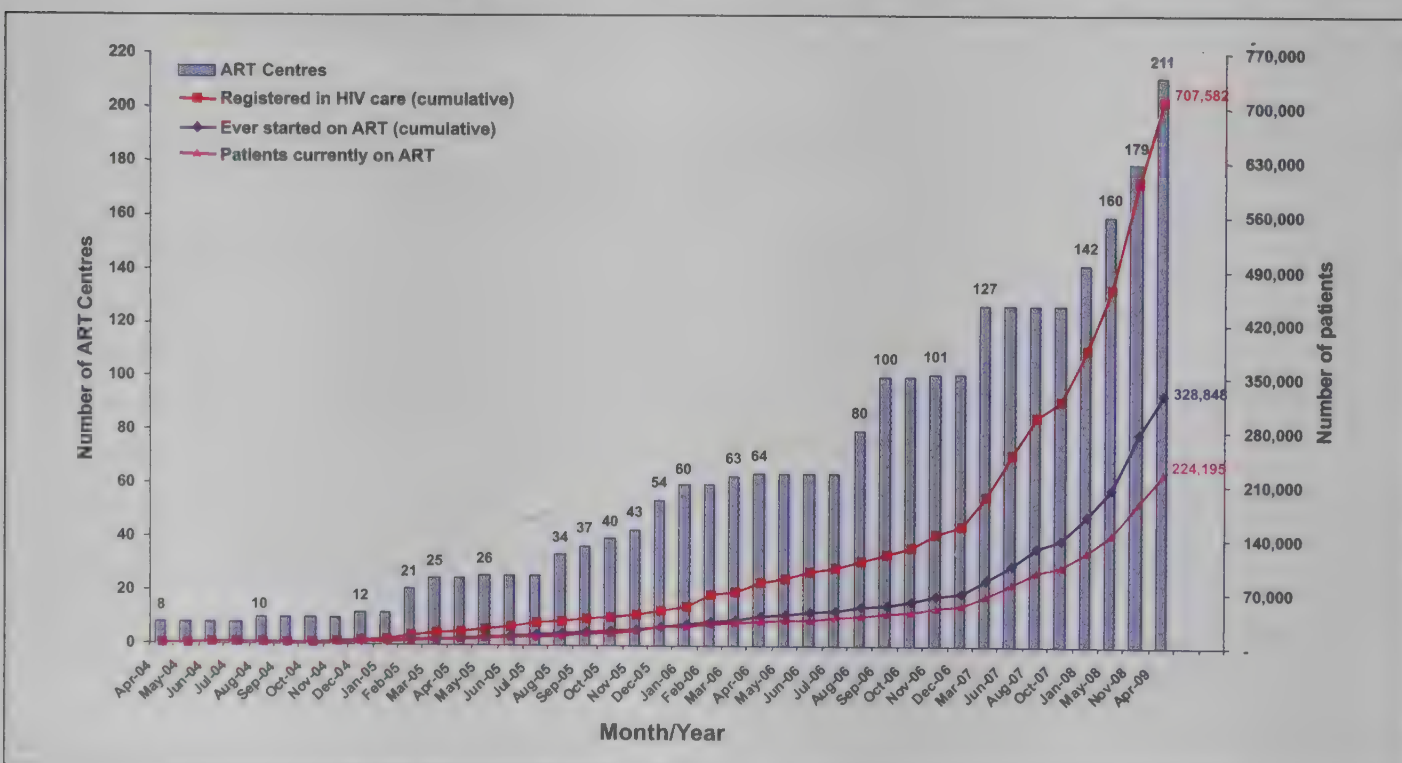
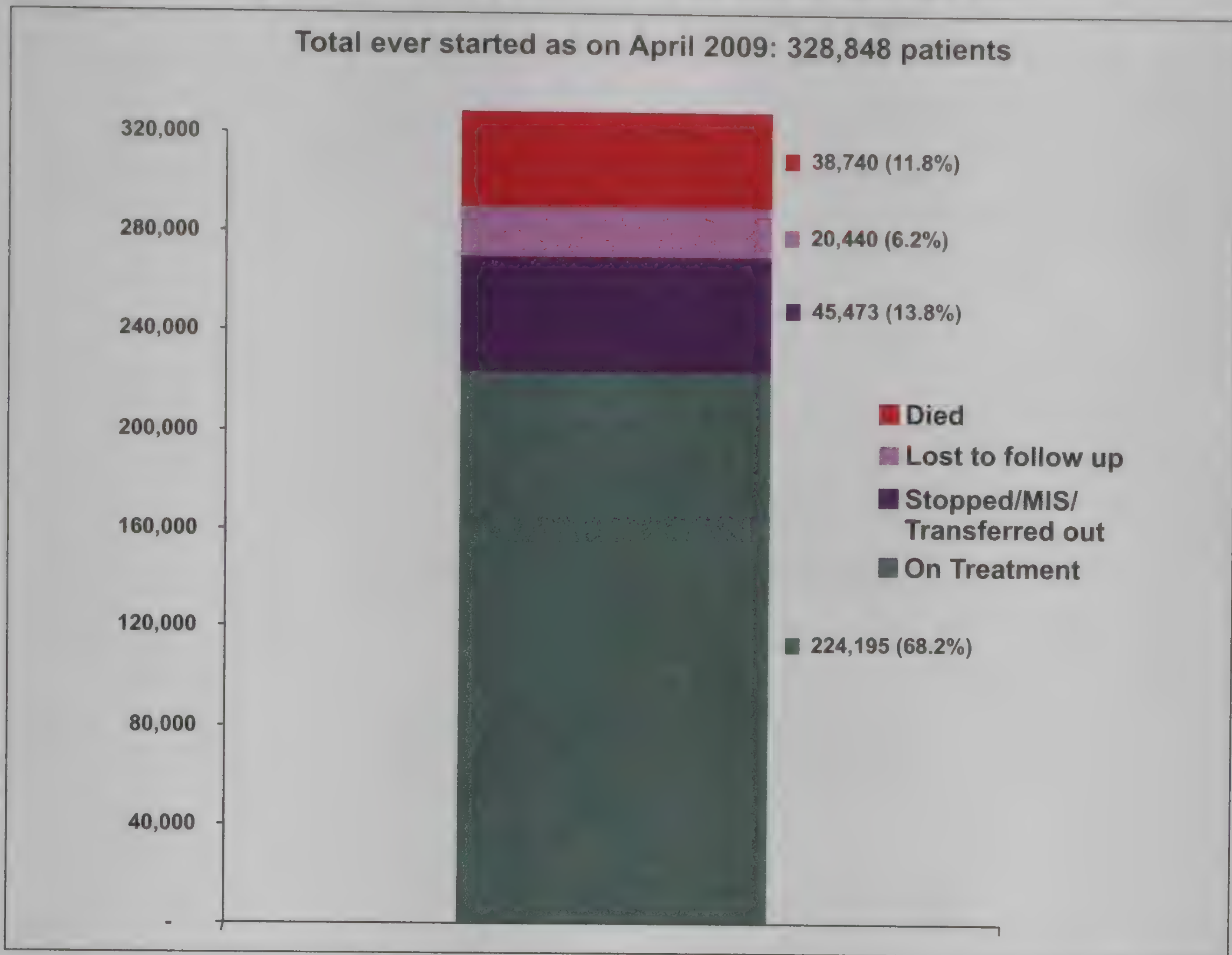


Fig. 6: Treatment status of all patients ever started on ART as on April 2009



Source: ART Centre Monthly Report, NACO

Many countries have committed themselves to universal access to HIV prevention, care and treatment by 2010. There are challenges to universal access in India. Universal access in a country that has low prevalence of HIV is a challenge. Consider PPTCT: there are 27 million pregnancies every year in India; about 70 000 of pregnant women are infected with HIV. The coverage of over 80% pregnant women is what WHO considers as universal. Another challenge is the need to move to more expensive second-line ART. Failing first line, patients need the second-line treatment, of which the cost is going up. Two thirds of the budget is allocated for prevention and one third for treatment. How is that going to be maintained when actually national budgets are not increasing? The main emphasis from the public health point of view in an HIV programme should be to improve prevention rather than having to treat. WHO has introduced new global guidelines which recommend earlier start and more expensive and slightly more tolerable regimens. If these guidelines are going to be implemented, more people will need to start the treatment early and will need to use more expensive drugs.

The HIV programme in India is relatively effective and is delivering impressive but hard-won gains that include maintaining the slow but steady drop in HIV prevalence. This may lead to less spending on prevention because it is working quite well. Complacency can be dangerous because although the programme is doing quite well in covering people in the most-risk groups with services, it has done very little in altering the structural drivers of the epidemic. If there is any significant cut-back in prevention interventions now, there would be a major rebound in the number of cases. One needs to advocate and make sure that this message is understood by policy-makers, health professionals and the infected and affected communities.

There is a historical lesson to learn from malaria. When malaria cases had dropped to almost zero in the late 1960s, funding for the extremely successful malaria control programme almost entirely ceased. Without any maintenance phase and without continued investment of resources, malaria rebounded. We need to remember the consequences of the failure to maintain malaria control services when these were needed the most. Finally, the drive for the promotion of universal access to HIV prevention, care and treatment needs to be maintained to achieve the global commitment made in 2005. There is a commitment and key countries and donors are alive to the need to continue to fund the universal access programme.

Parallel Session 6

Climate change: assessing vulnerability and defining adaptation strategies

Chairpersons: *Sattar Yoosuf*
Jacob Kumaresan

Session Coordinator: *A.P. Dash*

Climate change and human health: impacts, vulnerability and adaptation

Suruchi Bhadwal and Sneha Balakrishnan

Clean air, safe water, adequate food and secure shelter are essential requisites for sustaining the human population in a healthy state, and, since the climate system influences each of these, climate change emerges as an important risk factor impacting human health. The association between climatic variables and disease becomes evident through the observation that many diseases occur only during certain seasons or at places with a certain type of climate, or from sudden epidemiological eruptions after events of floods or droughts.

Global increases in greenhouse gas concentrations, primarily due to fossil fuel use and land-use changes, have altered the balance of the climate system and are drivers of anthropogenic climate change. The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report 2007*(1)* ranks 11 of the previous12 years (from 1965 to 2006) among the warmest years in the instrumental record of global surface temperature since 1850. Increases in sea level are consistent with warming.

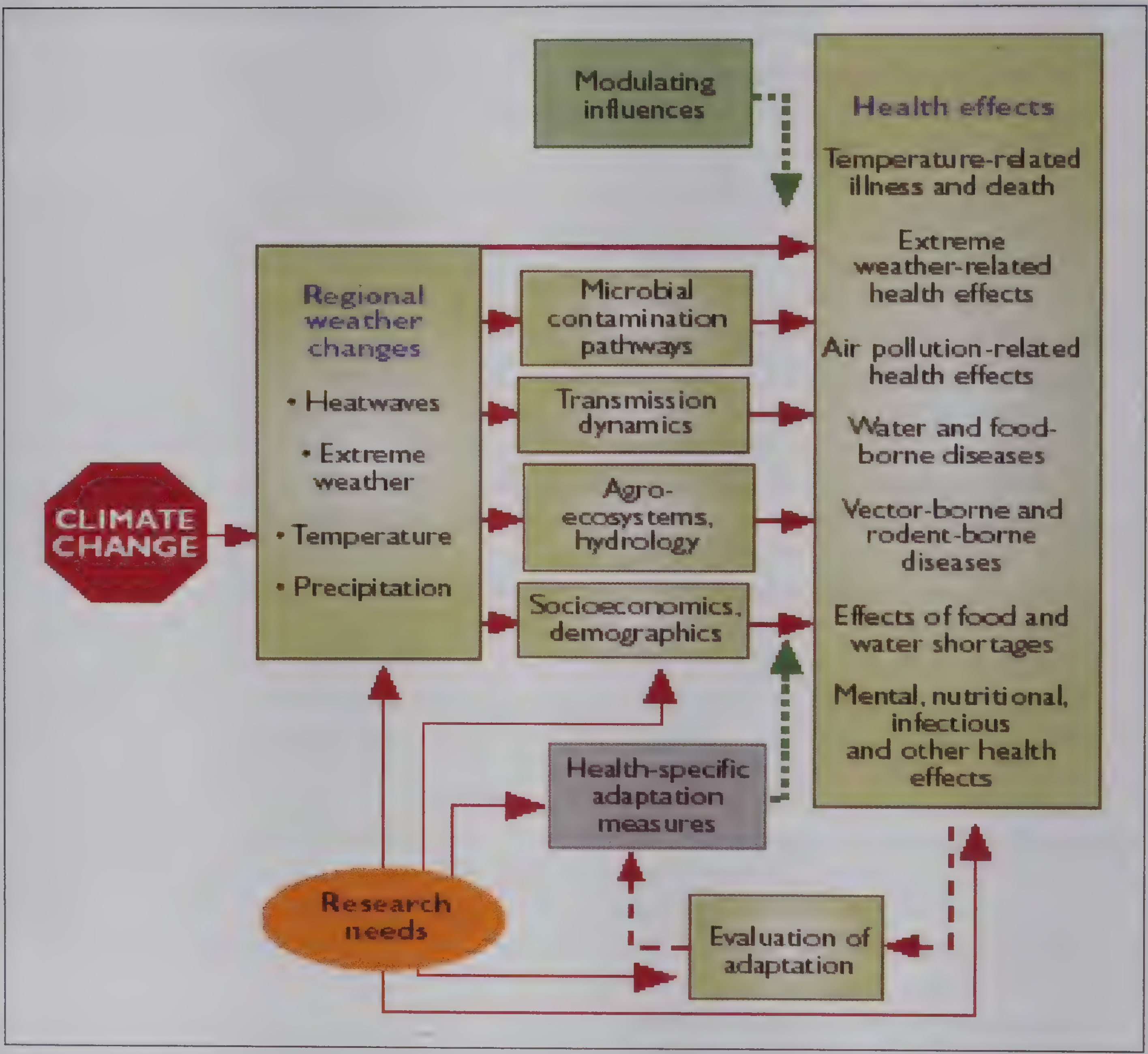
Significant warming of the order of 0.4 °C in the past 100 years (1901-2000) in the all-India and regional mean seasonal and annual surface air temperature has already been observed. A significant and consistent warming of the sea surface has also been recorded to have occurred over the Indian Ocean, the Bay of Bengal and the Arabian Sea during the 20th century *(2)*. While the annual average monsoon rainfall at the all-India level for the same period has been without any trend and variations have been random in nature, increases in the monsoon seasonal rainfall have been recorded along the west coast, north Andhra Pradesh and north-west India (+10% to +12% of normal/100 years). Decreasing trends have been observed over east Madhya Pradesh and adjoining areas, north-east India and parts of Gujarat and Kerala (-6% to -8% of normal/100 years). Observational data for day- and night-time temperatures have also shown an increasing trend in the maximum temperatures *(2)*. There has also been a notable increase in extreme rainfall events during the summer monsoon in recent decades in the Indian sub-continent as reflected by the incidences of serious and recurrent floods in Bangladesh, Nepal and the north-eastern states of India during 2002, 2003 and 2004; a record rainfall of 944 mm in Mumbai in July 2005 which led to a loss of over 1000 lives; and floods in Surat (Gujarat), Barmer (Rajasthan) and Srinagar (Jammu & Kashmir) during the summer monsoon season of 2006 *(3)*. And though the frequency of monsoon depressions and cyclone formations in the Bay of Bengal and the Arabian Sea has been on the decline since 1970, the intensity is increasing, causing severe floods in terms of damage to life and property *(4, 5)*.

Given the changing climate and the fact that seasonal patterns and climate sensitivities of many of the infectious diseases are well-known, the question of concern relates to the extent to which changes in disease patterns will occur under conditions of global climate change and how effective adaptation can help reduce people's vulnerability to increased health risks.

What impacts can climate change have on human health?

Changes in weather and climate can exert a major influence on human health, both through direct effects of extreme events such as heatwaves, floods and storms, as well as through indirect influences on the distribution and transmission intensity of infectious diseases. However, a number of non-climatic factors (modulating factors) such as population growth and demographic change, access to clean water, adequate nutrition and sanitation facilities, improvements in health care and disease prevention and control programmes influence the magnitude of climate-related health outcomes. Fig. 1 depicts the major pathways (direct and indirect) through which climate change can influence health. It also highlights the fact that modulating factors and adaptation responses can influence the outcome of the impact. Some of the major impacts of climate change on human health are discussed in the following sections.

Fig. 1. Pathways by which climate change affects human health, including local modulating influences and the feedback influence of adaptation measures



(Source: WHO, 2003) (6).

Thermal extremes

The increased frequency and intensity of extreme temperatures may have direct impacts on human health in terms of thermal stresses, such as hypothermia, influenza, cardiovascular and respiratory diseases, heat exhaustion, heat cramps, dehydration and many others *(7, 8)*. These may lead to higher levels of urban air pollution and humidity or exacerbate pre-existing respiratory problems *(9-11)*.

It has been postulated that the increase in heat-related stresses may be compensated by a decrease in cold-related illnesses in the winter season, leading to an overall positive impact *(12-14)*. These effects are nevertheless under debate, as the projected mortality for winter diseases might be underestimated if the effect of influenza is not considered *(15)*. Further research is needed in this context to identify the impacts under different climatic conditions and socioeconomic scenarios.

Air pollutants and aero-allergens

Weather conditions can affect the transportation of airborne pollutants (reduced atmospheric dispersion and diffusion) and production of certain kinds of pollen. Asthma, allergies and other acute and chronic respiratory disorders are generally associated with such episodes of air pollution *(16,17)*. Increased temperature is also expected to increase the frequency and/or intensity of forest and range-land fires. The increased particulate exposure due to the resulting smoke and particulate matter may lead to respiratory and cardiovascular conditions *(18)*.

Extreme events

According to the IPCC Fourth Assessment Report, any regional increases in climate extremes (e.g. storms, floods, cyclones, droughts) associated with climate change would cause deaths and injuries, population displacement, adverse effects on food production, freshwater availability and quality, and would increase the risks of infectious diseases, particularly in low-income countries *(19)*.

The health effects of flooding include deaths and injuries (direct impact) as well as indirect effects such as mental health problems (anxiety and depression) and increased water-borne diseases (e.g. diarrhoea, cholera, typhoid) due to water contamination *(20, 21)*. Unsafe sanitary conditions and decreased water accessibility further increase the chances of transmission of water-borne infections. Crowding, common in populations displaced by climatic disasters like floods, can further facilitate the transmission of communicable diseases *(22)*. Extreme events of weather can also severely disrupt the public health care facilities as well as emergency support services. It can temporarily lead to suspension of disease control programmes due to inaccessibility of the affected region or due to economic crisis arising after an event of a climatic disaster or epidemic. Of particular concern is the impact of sea-level rise, especially in the coastal and low-lying areas where population displacement and mass migration may impact the socioeconomic conditions of both the affected region as well as the region to which the migration takes place *(23)*. Drought events may cause increased malnutrition and undernutrition due to loss in agricultural production and increased infectious and respiratory diseases *(24)*.

Infectious diseases

Other indirect impacts of changes in weather patterns include variation in the geographical and seasonal distribution of vector-borne diseases *(25-28)*. The risk of malaria might increase in some regions in central Asia and India *(29)*, while in other areas (Central America and Amazon) the transmission could decrease because of reduced rainfall. Some regions are expected to have a longer transmission season, with important implications for vector control programmes. Populations at the

margins of the current distribution of diseases might be particularly affected since such populations have not evolved natural coping mechanisms unlike populations in endemic areas. However, there is still a considerable uncertainty regarding the modelling of the magnitude of the overall impact of malaria.

Finally, higher temperatures can lead to increased exposure to water- and food-borne diseases. This may be attributed to the direct effect of temperature on the growth of disease-causing organisms in the environment *(30, 31)*. According to some studies, increasing sea surface temperature can also directly influence the viability of the enteric pathogen, *Vibrio cholerae,* by creating favourable conditions for the growth of certain blue-green algae, zooplankton and copepods, which act as the reservoirs for the pathogen *(32, 33)*.

Malnutrition

It is projected in a range of studies that climate change may lead to increases in the crop yield potential at higher latitudes, but, at the same time, to a decrease in the tropics and subtropics, aggravating hunger and poverty in these areas. The risks from increasing extreme events of temperature and rainfall are bound to have negative consequences. In some areas, warmer temperatures may offer opportunities to cultivate new crops, but, in others, rising temperatures may make it more difficult to grow traditional, culturally acceptable, staple crops. Floods are a particularly challenging problem as, apart from damaging crops, they also create favourable breeding conditions for agricultural pests, such as insects, blights and fungi, and cause soil erosion. Another consequence of climate change, as quoted in many studies, is the "carbon fertilization" effect resulting from higher ambient CO_2 levels. It is postulated that this increase in productivity may offset some of the losses due to other impacts, but more research is needed in this regard *(34)* as the beneficial effects of elevated CO_2 must be considered in the light of the accompanying changes in air temperature, moisture availability, survival and distribution of pest populations, frequency and intensity of inter- and intra-seasonal droughts and floods, soil organic matter transformations, soil erosion, decline in arable areas due to submergence of coastal lands, etc. *(35)*.

The Indian scenario: evidences from literature

India, with a large population and an economy closely related to the natural resource base, is highly vulnerable to climate change impacts, including that on health. According to observations of past and present climatic trends, there has been a clear increase in the average surface temperatures in India in the past 100 years, along with regional increasing or decreasing trends in the rainfall *(2)*. A number of studies highlight the high climate sensitivity of population health in India and susceptibility to future health risks.

De and Mukhopadhyay (1998) reported a severe heatwave in May 1998, where the condition started in the north-western part of the country and gradually progressed to the south and south-eastern coastal states, causing large numbers of heat-related causalities in these regions *(36)*. Chaudhury et al. (2000), who assessed the impact of heatwaves in India, found that the maximum impact of heatwaves was felt in regions where the normal maximum temperature itself is more than 40 °C (mostly the north-western region) *(37)*. While the maximum frequency of heatwaves over most of the states was in the month of May, the number of heatwaves over Bihar, Rajasthan and Uttar Pradesh was more during the month of June, compared to other months. They also reported that casualties due to heat stress were more in the years succeeding an El Nino year over India. Takahashi et al. (2007) also projected excess mortality due to thermal stresses in India *(38)*. Apart from having severe direct implications on health,

prolonged heat may also lead to water scarcity and loss of soil moisture, which can adversely affect agricultural processes and production, especially if there is a delay in the annual monsoons.

Hajat et al. (2005), who looked at the heat-related mortality in New Delhi revealed an increase in the daily all-cause mortality with the same-day and previous-day temperatures greater than a threshold of 20 °C *(39)*. A study by McMichael et al. (2008), examining heat-related mortality in urban populations of 12 cities worldwide, also found that in New Delhi, the death rates were low during the coolest periods of the year and the highest just after the monsoons *(40)*. Heat-related fluctuation in mortality was found to be high, with a positive association between temperature and mortality throughout the temperature range of the city. The percentage increase in mortality (all-cause) was 3.94% for each degree Celsius increase in temperature above the city's heat threshold, one of the highest among the 12 cities under analysis. A separate analysis of cardio-respiratory and non-cardio-respiratory diseases showed that the percentage increase in mortality for each degree Celsius increase above the 'heat threshold' was 3.94% and 4.30% respectively. The increase in respiratory diseases can be attributed to air pollutant-temperature interactions, which are augmented by higher temperatures. Thus, with temperatures rising and heatwave duration and intensity increasing, a manifold increase in heat-related disorders can be expected.

Since temperature and humidity are key determinants in the transmission of many infectious diseases such as malaria and diarrhoea, changes in the patterns of temperature, rainfall and extreme events can lead to an impact on the incidence of these diseases. Bhattacharya et al. (2006) projected spread of malaria transmission to new geographical regions in India. According to this study, malaria transmission is projected to move from central regions towards south-western and northern regions by 2050 *(29)*. Apart from the spatial shifts, some temporal shifts in the transmission season were also reported. Akhtar et al. (2002), who studied the shifts in the patterns of malaria incidence in urban areas of India, found that, despite all efforts made by the State to control malaria, the disease was still widespread in the country, with urban areas becoming greater targets for the vector. Urban settings like slum areas, construction activities and green belts, which favoured the development of the vector, were acting as its habitats *(41)*. Thus, any changes in the climatic variables towards a more favourable condition for malarial transmission would lead to an increased burden on the urban health infrastructure.

When effects of seasonality and other temporal patterns on the occurrence of rotavirus diarrhoea were studied among hospitalized cases at Pune, India *(42)*, the statistical model suggested a strong influence of climatic changes on the incidence of the disease, with daily minimum temperature acting as the principal factor. Flood- related increases in diarrhoeal disease have been reported in India *(43, 44)*.

In India, substantial research has also been conducted for understanding the impact that climatic change might have on different crop yields and overall food security of the country (35, 45). Most of the simulation studies have shown a decrease in the duration and yield of crops as temperature increased in different parts of India (46). These reductions were, however, generally offset by the increase in CO2, the magnitude of this response varying with crop, region and the climate change scenario chosen. Under an optimistic scenario*, the effect on the rice yield remains positive (5%-20%) up to the year 2070. In comparison, the effect on wheat may either be positive (up to 25%) or negative (up to 30%), depending upon the magnitude of the change in CO2 and temperature. This impact assessment analysis, when extended to different climate change scenarios of 2100, shows that irrigated

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* The optimistic scenario includes a significant increase in CO_2 and a negligible increase in temperature, whereas the pessimistic scenario reflects low increase in CO2 and a high increase in temperature.

rice yields register a small gain in all regions in India irrespective of the scenario. Wheat yields in central India are likely to suffer by up to 2% in the pessimistic scenario but there is also a possibility of a beneficial effect (yield increase up to 6%) if the global change is optimistic (2). Since most of the cultivated land in India is rain fed and agricultural success heavily dependent on the annual monsoons, the agricultural performance and well-being of the Indian farmer is highly climate-sensitive.

Vulnerability to health impacts in India

The Intergovernmental Panel on Climate Change (2001) *(47)* states that the vulnerability of a system to climatic stress is a composite of the exposure to the stress, sensitivity to the stress and the ability of the system to adapt to the stress. Thus, apart from exposure to the climatic stress, a wide range of non-climatic factors play a crucial role in determining the sensitivity and coping capacity of the people. The most vulnerable are often those who are most exposed to hazards or those who are most sensitive to the impacts due to changes in climatic patterns, and/or those who have limited resources to cope or adapt to climatic shocks and stresses.

Urban areas are expected to get particularly affected by heatwaves, with the so-called "heat island" effect, which occurs as ambient temperatures in a city become much higher than those in adjoining suburban or rural areas, mainly due to concentration of anthropogenic activities and a higher density of concrete structures *(48, 49)*. Since the exposure levels are high for outdoor labourers, urban poor, slum dwellers and those without access to minimum standards of insulation or cooling, are expected to be at higher risk than those with higher adaptive capacity.

Furthermore, tropical cyclones and associated storm surges and extreme rainfall events are already common in the coastal areas of the country. Climate change might significantly alter the dynamics of these events, possibly increasing their frequency and intensity. Low-lying regions, including small islands, will face the highest exposure to the rising sea levels, increasing the frequency of floods, cyclones and other secondary impacts such as salt-water intrusion, ecosystem and biodiversity loss, etc., causing immense damage to human health directly and indirectly.

Biological factors also contribute to differential sensitivity and vulnerability. In general, groups at higher risk include the elderly, infants, children, women in reproductive age group and those who are already in poor health or are suffering from some health condition.

In general, developing countries are more vulnerable, with lower adaptive capacity attributable to inadequate access to infrastructure such as water, sanitation, poor status of existing health care systems and poor health status of the people. Inadequate financial, social and technological resources and other support systems and safeguards that are essential to protect people from immediate and longer-term health stresses also contribute to people's vulnerability. The IPCC (2001) *(47)* identifies economic wealth, technology, information and skills, infrastructure, institutions and equity among the factors that determine the adaptive capacities of vulnerable communities.

Since India is one of the most populated countries in the world, its population growth becomes an important additional aspect that needs to be considered. This is likely to increase the pressure on natural and socioeconomic resources, in particular, the access to water, food, health care system, which, in turn, will exacerbate the negative impacts of climate change on population health. This, together with high poverty levels, can contribute significantly to high sensitivity to climate change.

Even without climate change, competition for land and water is high in India. Multiple stresses such as limited water availability, pest resistance, biodiversity loss, soil erosion, salinity of irrigated lands, degradation of pastures, water pollution and over-exploitation of stock increase current sensitivity and reduce resilience of the food-producing sectors such as agriculture, forestry, fisheries

and animal husbandry. These existing vulnerabilities lead to reduced resilience of the food systems, thereby aggravating the risk of malnutrition and undernutrition-related disorders. While the lack of sufficient income to purchase food is a major factor causing households to face food insecurity, hunger itself contributes to poverty by lowering labour productivity, reducing resistance to disease and depressing educational achievements *(50)*. This vicious cycle between 'food insecurity-malnutrition' and 'livelihood loss-poverty' further reduces the adaptive capacity and increases the vulnerability of households and society as a whole.

Thus, when looked at in the light of existing vulnerabilities (in terms of exposure, sensitivity and adaptive capacity), climate changes can be considered as an additional stressor on human health, especially in the context of a developing country. For an emerging economy such as India, which is expected to benefit from the economic growth that would increase social welfare and technological development in the next decades, it is crucial to understand how climate change is likely to impact development priorities if we are to respond with appropriate and cost-effective measures for adaptation.

Assessing the impacts: what are the gaps?

Various methodologies have been developed to assess the likely impacts of climate change on health, such as scenario-based assessments, empirical disease models based on the current geographical distribution of climate-sensitive diseases, statistical assessments and, more recently, integrated assessments. However, a number of factors limit the accuracy of modelling and quantification of health impacts of climate variability and climate change.

Firstly, although in such analysis it is important to account for non-climatic influences that would affect disease rates, such as seasonal trends unrelated to climate, variations in socioeconomic conditions, immunity patterns and drug resistance, the data available at present do not allow for robust inclusion of such confounding factors *(19)*. Secondly, climate change occurs against the backdrop of natural climate variability, so it becomes difficult to determine how much disease is attributable to natural climatic variability and how much to anthropogenic climate change. Also, the effect of climate on human health is not always direct. In most cases, the influences are mediated through long, complex causal pathways that are difficult to account for in statistical analysis. Then there is also the intricacy of generalizing health outcomes from one setting to another, when many diseases, such as malaria, have important local transmission dynamics that cannot easily be represented through simple statistical relationships.

Many standard epidemiology approaches and methods are inadequate to analyse how weather/climate influences human health because these exposures operate on a population level. In most cases data requirements are not met as long-term data sets on both climate and health outcome are not available, or, as in most cases, may not be on the same spatial and temporal scales as required.

Though it is important to determine climatic thresholds for various diseases, especially when there is a need for developing early warning systems and planning emergency responses, identifying climate-related thresholds for population health is a challenging task because of the incomplete understanding of the extent, rate, limiting forces and major drivers of climate-health interactions. Also, since populations differ in their adaptive capacities, this aspect needs to be captured by statistical models *(19)*.

There is presently little synchronization across disciplines and institutions; these links need to be established and sustained. Improved understanding is needed of how to incorporate outputs from multiple global climate models into health studies to bring to light better the variety of uncertainties

coupled with projected future health impacts. According to McMichael et al. (2003), "Including several climate scenarios can illustrate the range of possible future changes, thus allowing decision-makers to identify populations that may be particularly vulnerable to adverse health impacts, and to use this information when prioritizing strategies, policies and measures to enhance the adaptive capacity of future generations."*(23)*

Responding to change: adaptation in the health sector

In order to reduce the undesirable health impacts of climate change, various adaptation measures or strategies can be implemented. Adaptation in the context of health includes interventions which may be defined as "actions that involve making changes to the natural or human environment or to human behaviour that have beneficial impacts (or prevent adverse impacts) on the health of humans"*(51)*. Besides environmental health interventions, adaptation programmes for health include also the typical public health measures like curative interventions.

Adaptation can be defined according to the purpose (autonomous and planned), the timing (preventive and reactive), the temporal scope (short term and long term), the spatial scope (localized and spread), the form (legal, technical, research-oriented, advisory and behavioural), the function (structural and non-structural), and the valuation of performance (effectiveness-feasibility) *(52)*. Some of the key responses that can be considered to make the health sector more climate-resilient are summed up in the points below:

- There is a need to increase active global disease surveillance as the lack of precise knowledge of current disease incidence rates makes it difficult to comment on the causes of changing rates *(23)*. Such data would also help in validating predictive models as well as provide for baseline scenarios. Ultimately, only better assessment and monitoring can allow for better prevention and control in order to limit the impacts of change.
- There is a need for a more in-depth epidemiological research into associations between climatic factors and infectious diseases across diverse populations and geographical regions. Integrating the effects of social and environmental influences into climate-disease models is difficult but necessary in order to completely understand the dynamics of their association. Thus, it is vital to further the development of comprehensive models which can forecast likely health outcomes under different scenarios of climate change as well as across a range of socioeconomic scenarios.
- Though a substantial amount of knowledge has been accumulated on the relationship between climate variations (either over short time-periods or geographically) and some health outcomes such as malaria and diarrhoea, quantitative relationships are yet to be established for many other important health outcomes which are understood to be climate-sensitive, such as changes in air pollution or aero-allergen levels, emergence or spread of pathogens via climate change-driven biodiversity loss, impacts of health infrastructure loss due to extreme events such as flooding, cyclone, etc. A close look at the adaptive capacity of disease-causing organisms as well as their vectors is another challenging but crucial task.
- Weak public health systems and limited access to primary health care contribute to high levels of vulnerability and low adaptive capacity for hundreds of millions of people. Under a future climate change scenario, expansion and improvements in water, sanitation, nutritional programmes and, most importantly, health care facilities, must be prioritized. An improvement in public health infrastructure, which includes public health training, emergency response and prevention and control programmes, is indispensable.

- A superior understanding of existing adaptive capacity of individuals as well as of the population as whole, as well as the adaptation deficit, would essentially help in better planning of response measures and resource allocation. Current national and international programmes and measures that aim to reduce the burdens of climate-sensitive health outcomes may need to be revised, reoriented and, in some regions, expanded, to address the additional pressures of climate change.

In summary, the need of the hour is to undertake in-depth assessments of the likely health risks due to climate change, identify which actions will be most effective in adapting to climate change, and, most importantly, integrate adaptation strategies into existing development planning. Thus, convergence of expertise of various stakeholders along with improved methods and databases from various disciplines is necessary to understand the dynamics of the intricate association between health and climate, and to respond to different scenarios and associated impacts on population health in the future.

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Impact of climate change on diarrhoeal diseases, especially cholera, in India

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The global climate is known to be altered by human activities. The energy-trapping gases are increasing in the atmosphere, thereby amplifying the natural greenhouse effect due to developmental activities. There is new and stronger evidence showing that most of the warming observed over the last 50 years is attributable to human activities *(1)*. Since 1990, there is a significant variation in the mean state of climate or in its variability persisting for an extended period (decades or longer), leading to climate change. The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as a 'change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, which is in addition to natural climate variability observed over comparable time periods' *(1,2)*.

Scientific evidence of climate change

As per the Intergovernmental Panel on Climate Change (IPCC)'s Third Assessment Report, about 3.8 ºC rise in temperature and 7% change in precipitation (either increase or decrease) are projected by 2080 *(1)*. The Fourth Assessment report of the IPCC *(2)* also projects a rise in temperature up to 4 ºC and a sea-level rise up to 0.59 m by 2100. Based on a range of models, it is likely that future tropical cyclones (typhoons and hurricanes) will become more intense, with larger peak wind speeds and more heavy precipitation associated with ongoing increases of tropical sea surface temperatures. Since 2002, India has also initiated studies on an assessment of the vulnerability, due to climate change, of different diseases. This paper provides an overview of the threat, due to climate change, of diarrhoeal diseases and cholera.

Climate and diarrhoea

A recent review of global deaths of children aged less than 5 years from diarrhoea estimated the number at 1.87 million, which is approximately 19% of the total child deaths. The WHO African and South-East Asian regions combined comprise 78% (1.46 million) of all diarrhoeal deaths occurring among children in the developing world, with 73% of these deaths concentrated in just 15 countries *(3)*. The morbidity due to diarrhoeal diseases is also very high. Globally, 1.3 billion episodes of diarrhoea occur annually, mostly in children, with an average of 2 to 3 episodes per child per year *(4)*. The global diarrhoeal disease burden was estimated at 62 451 000 disability-adjusted life years (DALYs) lost in 2001*(5)*. The majority of the DALYs are from developing countries where children suffer from as many as 12 episodes of diarrhoea each year. In fact, in certain areas with poor environmental sanitation, children are ill with diarrhoea for 10%–20% of the first three years of their life.

In developing countries, up to a third of paediatric admissions in hospitals are due to acute diarrhoea. Besides this mind-boggling burden, it is one of the most important health-related impacts linked

to short-term and long-term changes in the climate. The frequency and intensity of occurrence of extreme climate events such as droughts, floods and cyclones have a direct impact on the prevalence of diarrhoeal diseases. Studies from developing countries show that there are strong seasonal variations in the incidence of diarrhoeal diseases in case of hydrological extremes such as water shortages and flooding. Water shortages cause diarrhoea due to perpetuation of unhygienic and poor sanitary conditions, and flooding contaminates drinking-water supplies.

Attempts were made to apply various statistical methods to show an inherent association between change in climate for a considerable period of time and prevalence of diarrhoeal diseases, with special reference to cholera, which is a sensitive marker for climate variation. Some attempts were made earlier to show that environmental and climatic factors which cause seasonal patterns of infection are the key factors for the temporal variation of the disease, but that too in localized areas *(6-8)*. In the context to this theory, several researchers have established a link between heavy rainfall and flooding—whether resulting from El Niño-associated events or from other meteorological impacts—and subsequent outbreaks of infectious diseases *(9)*. These climatic conditions are intermingled with other environmental and climatic conditions which also play a profound role in the variation in the incidence of diarrhoeal diseases.

Extreme meteorological events can easily disrupt water purification and storm-water and sewage systems, as well as contaminate uncovered wells and surface water, leading to an increased risk of illness. These risks are even higher when a population lives in a low-lying area where the land's hydrology causes draining tributaries to meet. Conversely, heavy rains and coastal events can also flush microorganisms into watersheds, affecting that up-coast as well.

Severe weather events appear to be correlated with enteric diseases, such as outbreaks of cryptosporidiosis related to excessive demand placed on sewage treatment plants from heavy rains and flooding *(10)*. Other reports have also demonstrated an El Niño–Southern Oscillation (ENSO) connection to rates of enteric illness *(11-14)* in South America, levels of enteric microorganisms in coastal areas of south Florida (United States) and cholera in Bangladesh *(15-17)*.

Climate variation also influences the presence of non-enteric and other naturally present pathogens in the environment. *Vibrio parahaemolyticus* and *Vibrio vulnificus* are responsible for a majority of the non-viral infections related to shellfish consumption in the United States *(18)* and also result in infections of open wounds during recreational exposure, such as swimming and fishing. Along with *V. cholerae*, these bacteria thrive in warm waters of moderate salinity *(14-16)* and are closely associated with aquatic invertebrates. Therefore, with changing climate, the geographical range of these pathogens may also change, potentially resulting in increased exposure and risk of infection for humans. Furthermore, changes in plankton populations, and other hosts for which vibrios are commensals or symbionts, would similarly alter the ecology of these pathogens.

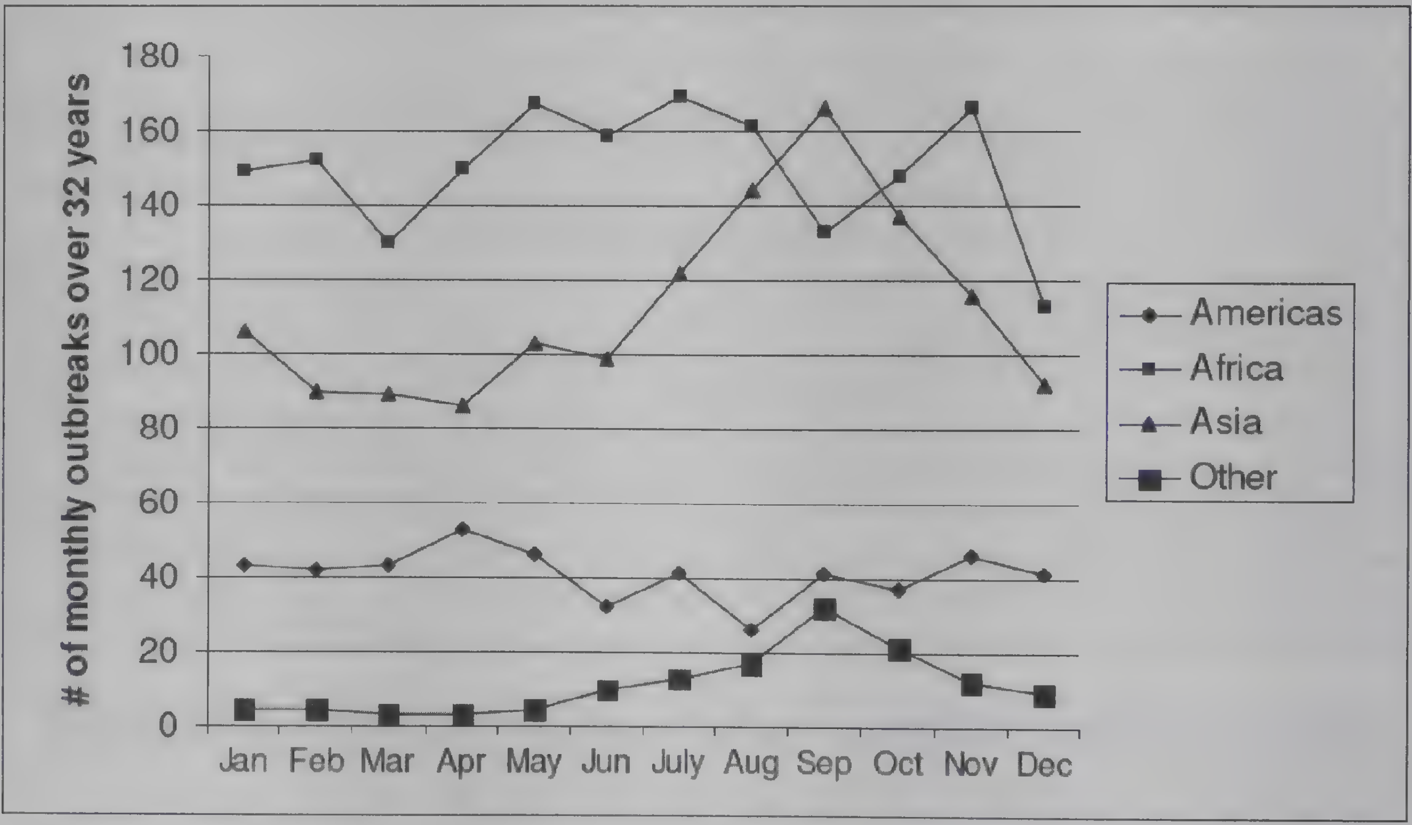
Evidences of impact of climate change on the occurrence of cholera

Among water-borne diseases, cholera is a climate-sensitive disease of great importance. Concerns over the impact of anthropogenic alterations to both terrestrial and aquatic habitats, coupled with a changing global climate, provoked scientists across the globe to find out a multidisciplinary approach to understand the dynamics of certain diseases in relation to climate changes, especially cholera *(15)*. We now know that many factors have contributed to the persistence and increase in the occurrence of infectious diseases, such as environmental and other non-environmental socioeconomic changes like deteriorating health care, mass food production, human behaviour, public health infrastructure and microbial adaptation.

Relation between climate extremes and cholera outbreak patterns

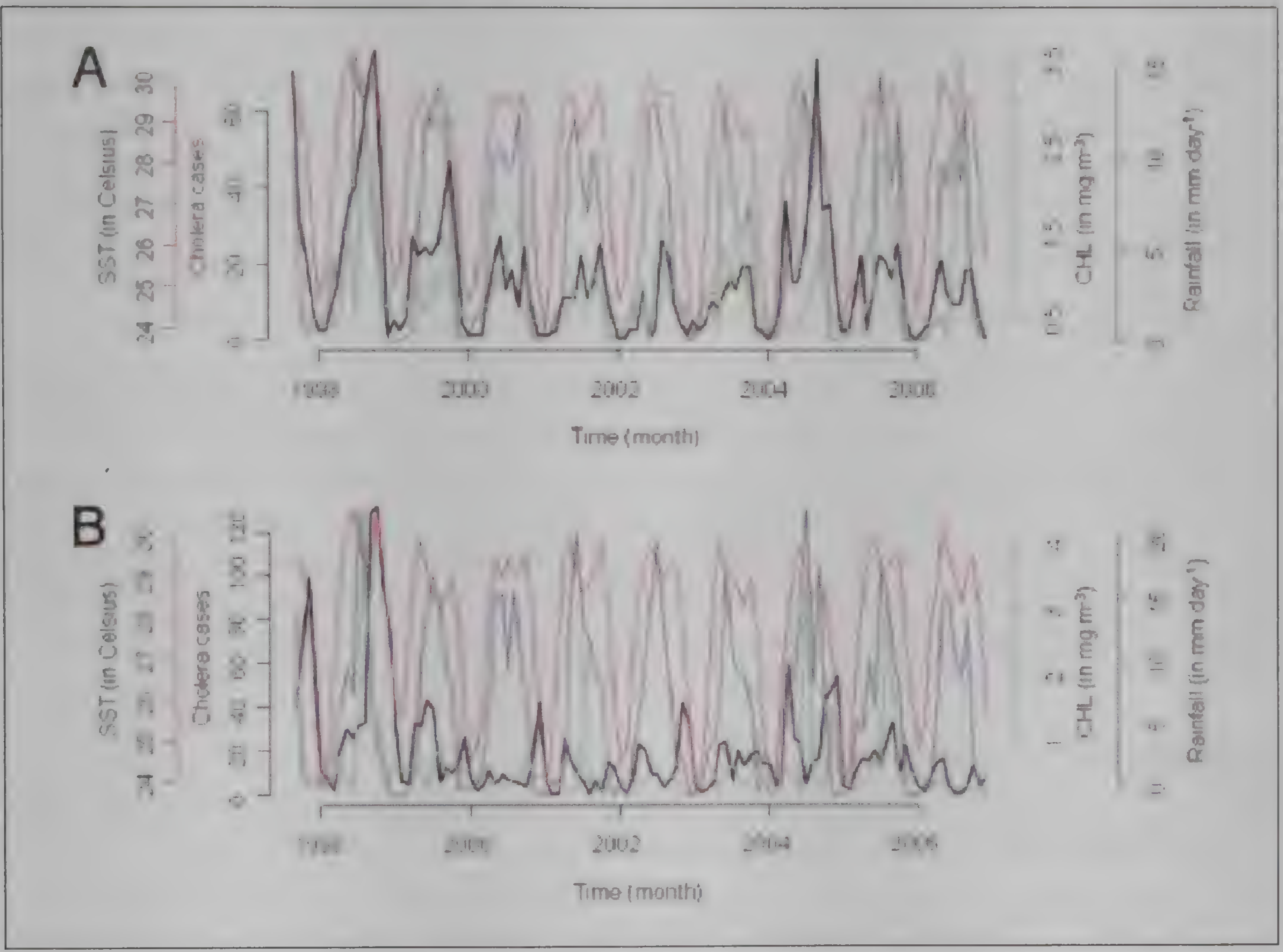
Toxigenic *V. cholerae* O1 or O139, the pathogens that cause cholera, are autochthonous to aquatic environs and are intricately associated with the microflora and fauna of aquatic environs, particularly zooplankton. *V. cholerae* utilizes chitin present in certain types of zooplankton as nutrients. Cholera has the ability to spread as a worldwide pandemic and currently the seventh pandemic of cholera, which started in 1961, is ongoing. WHO, in 2008, registered a total of 190 130 cases with 5143 deaths, with a case-fatality rate (CFR) of 2.7%. This shows an increase in the number of cases by 7.6% as well as an increase by 27% in the number of deaths compared to the previous year *(16)*. In some South Asian countries it is endemic, in some parts like Africa and South America, sporadic outbreaks occur, which is also a common feature in the endemic areas (Fig. 1). Past studies have shown how cholera varies with seasons *(17, 18)*. The outbreak pattern of cholera varies with season, mainly with heavy rainfall leading to water logging and lack of potable water, and the socioeconomic, environmental and climatic factors are all intermingled. Besides the rainfall, two remote drivers of inter-annual climate variability, the El Niño–Southern Oscillation (ENSO), sea surface temperatures (SSTs) and chlorophyll A in the Bay of Bengal are supposed to influence cholera in Bangladesh and India (Fig. 2) *(19)*. A recent review revealed that cholera in India is grossly underreported in the last decade (1997-2006), both in terms of disease burden and case-fatality rates, which highlights the magnitude of the problem *(20)*.

Fig.1: Monthly outbreaks of cholera by regions (19)



There are evidences of an increased role of inter-annual climate variability on the temporal dynamics of cholera, based on the time-series analyses of the relationship between ENSO and cholera prevalence. A change in remote ENSO modulation alone can only partially serve to substantiate the differences observed in cholera. For the recent cholera series, and during specific time intervals corresponding to local maxima in ENSO, this climate phenomenon accounts for over 70% of the disease variance *(21-22)*.

Fig. 2: Epidemiological and environmental dynamics for (A) Kolkata and (B) Bangladesh. Cholera cases, Cholorophyll A, SST and rainfall are shown in black, green, red and blue lines, respectively25 (reproduced with permission from the publisher of The National Academy of Sciences of the USA).



Evidence shows that there is existence of refractory periods during which climate-driven increases in transmission do not result in large outbreaks. Once the interplay of climate forcing and disease dynamics is taken into account, a clear evidence emerges for a role of climate variability in the transmission of cholera. A meta-analysis of 32 years of cholera data from WHO was attempted to see the association between cholera cases and different environmental factors like rainfall, sea-surface temperature, humidity and altitude *(21)*, which show a great variability in cholera incidences.

Additional variables like human, socioeconomic and demographic factors are also responsible for cholera outbreaks *(23)*. Environmental factors like increased temperature, salinity, pH, iron concentration, chitin level resulting from zooplankton bloom, etc., all result in an increased growth of *V. cholerae* and facilitate its survival in the environment *(24)*. Inverse correlation between environmental phage concentration (post-flood and post-monsoon periods) and epidemics has also been postulated recently *(25)*.

Effect of temperature variability

It has been predicted that over the next 100 years there will be a 1.4 °C to 5.8 °C rise in the mean temperatures, and this rise may cause an increase in the prevalence and endemicity of cholera and may affect a larger geographical region if public health measures are not implemented. *V. cholerae* O1 and other pathogenic vibrios grow well at higher temperatures; so, any rise in temperature will favourably affect the pathogen. As predicted with higher temperatures and melting of glaciers, the sea level may rise and this may cause incursion of salt water, resulting in more conducive conditions and increased

level of marine and estuarine pathogens, including *V. cholerae*. Changes in sunlight and/or ultraviolet intensity could increase the rates of induction and propagation of the CTXΦ phage and thereby increase the potential for the emergence of new toxigenic *V. cholerae* strains (26). In recent years, the emergence of newer variants of toxigenic *V. cholerae* as seen by the emergence of *V. cholerae* O13926 and the more recent demonstration of the El Tor variants of *V. cholerae* O1 that produce classical cholera toxin (27) indicate that the transmission of the disease is intensifying, enabling new variants to be generated by gene transfer. The recently described El Tor variant, which carries the classical biotype cholera toxin, is believed to enhance the severity of cholera (28). Another disturbing trend in recent years is the emergence of multidrug-resistant strains of *V. cholerae* O1 which was not witnessed before and is likely to pose a problem in the treatment of severe cholera.

Conclusion

As the transmission dynamics of diseases depend on various factors, including intervention measures and socioeconomic developments, the projections of transmission of diarrhoea and cholera should be viewed as possible guidelines with an element of uncertainty. The element of uncertainty is also accentuated by the quality of data that are available. We know that cholera is grossly underreported for a variety of reasons and for the lack of resources to have proper surveillance in place.. In the light of climatic and environmental drivers in disease dynamics, it is necessary to generate more concrete evidence of the impact of climate change on diarrhoeal diseases and to take into account the capabilities of public health systems for improved intervention efforts and preparedness.

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The impact of climate change on vector-borne diseases in Indonesia

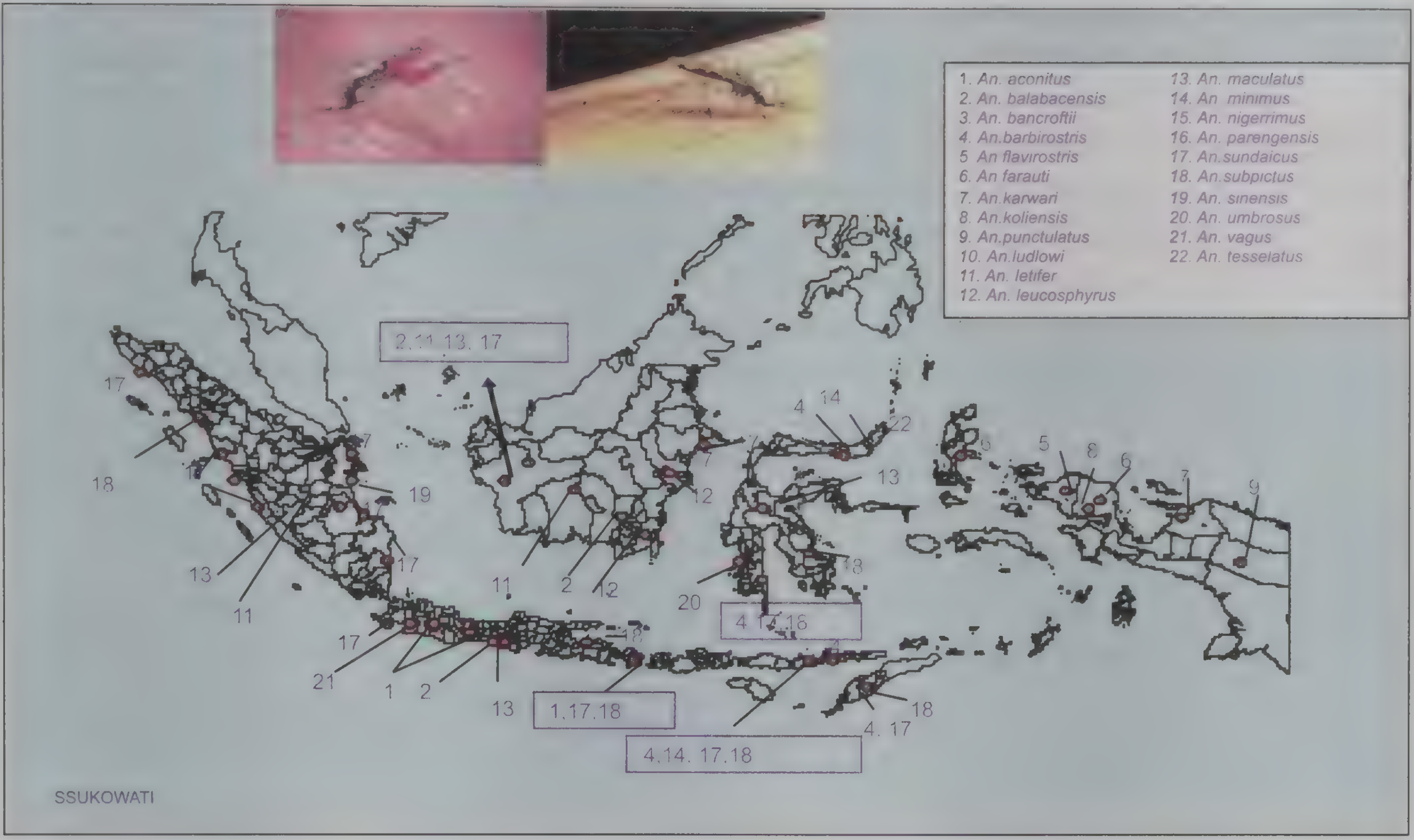
Supratman Sukowati

The climate is changing quite rapidly. The earth's surface has warmed up by more than 0.8 °C over the past century, and by approximately 0.6 °C in the past three decades. The CO_2 emissions continue to rise. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) projects a rise in temperature of up to 4 °C and of the sea level up to 0.59 metres by the year 2100. The risks are inequitable. The greenhouse gases that cause climate change originate mainly from developed countries but the health risks are concentrated in the poorest of nations which contribute the least to the problem. Many of the projected impacts on health are avoidable through a combination of public health interventions in the short term, support for adaptation measures in health-related sectors such as agriculture and water management, and a long-term strategy to reduce human impacts on climate.

The climate change hazards are diverse. They range from increased risks of extreme weather, such as heatwaves, floods and storms, to less dramatic but potentially more serious effects on the transmission dynamics of infectious disease. Climate change is a significant and emerging threat to public health. It calls for new ways of looking at protecting the vulnerable populations. In Indonesia, many important diseases are highly sensitive to changing temperatures and precipitation. These include common vector-borne diseases such as malaria, dengue fever/dengue haemorrhagic fever, chikungunya, lymphatic filariasis; zoonotic diseases such as plague, hantavirus, avian influenza; water-borne diseases such as diarrhoea, cholera, leptospirosis; airborne diseases such as acute respiratory diseases, influenza, asthma; as well as others such as malnutrition, etc. The IPCC reports of 2001 and 2007 conclude that climate change is likely to expand the geographical distribution of several vector-borne diseases. For some vector-borne diseases in some locations, climate change may decrease the transmission risk by a reduction in rainfall or a rise in temperatures that are too high for transmission.

The impacts of climate on human health will not be evenly distributed across Indonesia. The most vulnerable people are likely to be the poor population (45.2% or 105.3 million), coastal community (65% of the population in Java lives in the coastal area), old persons and children, traditional community, farmers and fishermen as well as people who live in Small Islands. Indonesia consists of approximately 17 457 islands located between 6 degrees north and 11 degrees south latitude, and from 95 to 141 degrees east longitude. The Indonesian archipelago lies between two continents – Asia and Australia. There are five major islands -- Sumatra, Java, Kalimantan, Sulawesi and Papua or Irian Jaya. Two remaining groups of islands are Moluccas and East Nusatenggara. Other islands are small and many of them are not inhabited. Indonesia's climate is tropical with two seasons, the dry season extends from May to October and the rainy season from November to April. For the last two decades, due to climate change, the dry and rainy seasons are not consistent in their time periods. Many poor populations living in Small Islands area, arid and high mountainous zones and in densely populated coastal areas are particularly vulnerable.

Fig. 1: Distribution of malaria vector species in Indonesia



Indonesia has a very rich and wide variety of insects as disease vectors, especially mosquitoes. The present distribution of the members of the family Culicidae, sub-family Anophelinae, corresponds remarkably well with Wallace's classification of the regions. Each region has its own characteristic anopheline fauna with some expectable overlap at the margins of adjacent regions. In terms of zoogeographical distribution, mosquito species in the western part of Indonesia belongs to Oriental fauna, though in the eastern part it belongs to Australasian fauna, and in between Wallace's and Weber's in the middle part of Indonesia, is a unique area, i.e. Sulawesi and its surrounding area, where the fauna is also unique and some of them overlap. The overlap is seen particularly in respect of the Oriental region, which is not separated from its neighbours to the east and the west by such insurmountable barriers as oceans or large deserts.

Vector-borne disease surveillance

Effective surveillance and response systems are essential in managing vector-borne diseases, but they become even more important under conditions of rapid change. These conditions include climatic shifts as well as increasing rates of movement of, and contact between, humans, pathogens and vectors. These conditions require improved human health surveillance integrated with monitoring of climate and other environmental conditions and vector density as well as vectorial capacity that favours disease outbreaks. Climate change also strengthens the case for reinforcing response systems for vector-borne disease outbreaks, including predefined action plans and maintenance of the control resources and personnel capacity necessary to mount effective responses.

Climate, weather and infectious diseases

Both temperature and surface water have important influences on vectors, particularly on mosquito species, which transmit malaria and viral diseases such as dengue. Temperature affects the developmental time of different stages of the life-cycle of mosquitoes, feeding rate, gonotrophic cycle

and longevity. Vectorial capacity and entomological inoculation rates are affected by the density of vectors in relation to the number of humans in a given local situation, daily survival rate and feeding rate of vectors and the duration of their sporogonic cycle. These stages are sensitive to changes in environmental temperature. Mosquitoes need access to stagnant water as breeding habitat and the adults need humid conditions for viability. Rainfall will create mosquito breeding places and/or flushing off of the immature stages of mosquitoes. Warmer temperatures enhance vector breeding and reduce the pathogen's maturation period. The vectors become more infective for transmission. However, very hot and dry conditions can reduce mosquito survival.

Malaria remains a serious threat to human health in Indonesia, its transmission is typically rural and localized, and the risk of transmission at each site depends on the presence or absence of competent malaria vectors. When competent vectors and malaria-infected humans interact, a stable pattern of endemic malaria transmission emerges. The disease's sensitivity to climate may increase its transmission in areas of unstable malaria in developing countries, where the populations lack protective immunity and are prone to epidemics when weather conditions facilitate transmission.

Dengue fever (DF)/dengue haemorrhagic fever (DF/DHF) is the most important arboviral disease of humans, occurring in tropical and subtropical regions, particularly in urban settings. El Nino-Southern Oscillation (ENSO) affects dengue occurrence by causing changes in household water-storage practices and surface- water pooling and will increase the breeding places for DF/DHF mosquito vector, *Aedes aegypti.*

Rodents, which are commensal in tropical areas such as Indonesia, can proliferate to act as reservoirs of various diseases. Certain rodent-borne diseases are associated with flooding; these include leptospirosis and tularemia and viral haemorrhagic diseases caused by hantavirus. Other diseases associated with rodents and flea, which are the result of climatic variability, include plague, tick-borne encephalitis and hantavirus pulmonary syndrome. The incidence of leptospirosis is significantly higher in tropical areas compared to temperate regions since warm temperatures prolong the persistence of the organism in the environment. Rats, mice, cattle, pigs and dogs are the domestic species most commonly implicated in the transmission of leptospirosis.

Many diarrhoeal diseases vary seasonally, suggesting sensitivity to climate. In the tropics including Indonesia, diarrhoeal diseases typically peak during the rainy season. Both floods and droughts increase the risk of diarrhoea. Major causes of diarrhoea linked to heavy rainfall and contaminated water supplies are: cholera, *cryptosporidium, E. coli* infection, *giardia, shigella*, typhoid and viruses such as hepatitis A. Climate change will affect the pattern of death from exposure to high or low temperatures. However, the effect on actual disease burden cannot be quantified. By 2030, the estimated risk of diarrhoea will be up to 10% higher in some regions than if no climate change occurred.

National health programmes should strengthen infectious disease surveillance and control to include health action in emergencies to protect lives from climate-related hazards and improve the capacity of health personnel at all levels of administration to face the additional risks posed by climate change.

Impact of climate change on vector-borne diseases

Episodes of El Niño have been more frequent, persistent and intense since the mid-1970s, compared with the previous 100 years. Changes in climate are likely to lengthen the transmission seasons of important vector-borne diseases and alter their geographical range, potentially bringing them to regions which lack either population immunity or a strong public health infrastructure.

DF/DHF is one of the important public health problems in Indonesia due to its high morbidity. DF/DHF outbreaks have occurred frequently in the last 10 years. In 1988, an outbreak caused 47 573 cases with an incidence rate (IR) of 27.09 per 100 000 population and 1527 deaths and a case-fatality rate (CFR) of 3.20%. Another outbreak was reported in 1998 with 72 133 cases (IR 35.19/100 000) and 1414 deaths (CFR 2.0%). In 2004, a nationwide outbreak occurred with 74 811 cases and 868 deaths (CFR 1.16%). In 2007, the number of cases was 56 697 (IR 71.43/100 000) with 1568 deaths (CFR 1%). DF/DHF cases have been reported from all over the country, both in rural and urban areas, and the number of cases tends to increase during the rainy season. The risk factors that influence the transmission of DF/DHF are climate change, environment, urbanization, high mobility of people, population density and transportation.

Strategies to reduce the impact of climate change

The impacts of current and future natural disasters can be reduced by the health sector formulating integrated measures that address the root causes of vulnerability and planning for effective responses after such events occur. For example, the health impacts of floods can be reduced by land management policies that reduce deforestation and conserve the integrity of watersheds and coastal zones, minimize the physical impacts of mudslides and storm surges and decrease the chances of sewage contamination. Post-flooding health effects can be reduced by adequately planned and funded health-sector responses, including interventions to control outbreaks of vector-borne and water-related diseases.

The programme to raise awareness of climate change implications for the health services of highly vulnerable regions should be integrated in development planning at all levels of administration. The Ministry of Health should head an intersectoral team that has identified priority health risks from climate change in local environmental, socioeconomic and health contexts. Through the course of this initiative, this team can identify, implement, monitor and refine interventions to minimize health risks.

Summary and conclusions

Climate change will affect the global pattern of vector-borne diseases. The estimated risk of vector-borne diseases in some regions is higher even if no climate change occurs. Since few studies have characterized this particular exposure-response relationship, these estimates remain uncertain. In addition, many important diseases in Indonesia are highly sensitive to changing temperatures and precipitation. These include common vector-borne diseases such as malaria, dengue fever, chikungunya, lymphatic filariasis; zoonotic diseases such as plague, hantavirus, avian influenza; water-borne diseases such as diarrhoea, cholera, leptospirosis; airborne diseases such as acute respiratory diseases, influenza, asthma; as well as others such as malnutrition, etc. The estimates of changes in the risk level of vector-borne diseases transmission are somewhat unstable because of regional and local variations in the rainfall in Indonesia.

There is sufficient evidence of a close association between climatic conditions and vector-borne diseases that are most sensitive to long-term climate change. Malaria and DF/DHF vary seasonally in highly endemic areas. The correlation of rainfall and high temperature was identified early on as a major influence, enhancing mosquito breeding places and survival and increasing the transmission risk factors. However, in contrast to many other risk factors, climate change and its associated risks are increasing rather than decreasing over time.

Research on climate change and vector-borne diseases, especially studies of the causal relationships, risk assessment, evaluation of population vulnerability and adaptive capacity and evaluation of intervention policies, are needed in Indonesia.

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Climate change and health research in Nepal

Gajananda Prakash Bhandari

Climate change has been defined as "change in the state of climate that can be identified by changes in the mean of variables of its properties that persist for an extended period" *(1)*. Global temperature has risen by 0.74 degrees Celsius in the past 100 years and it may rise up to 5 degrees Celsius by 2080 *(2)*. The effect of climate change on human health has been predicted globally *(3)*. There is a need for research at national level to understand the health impact of the climate change so as to formulate an evidence-based policy and adaptation strategy. The overall objective of the research project undertaken in Nepal was to assess the relationship between climatic variables, diarrhoeal disease and malaria, and also to find out the range of non-climatic factors that can confound the relationship of climate change and human health.

Secondary data from year 1999 to 2008 was collected in one of the districts (Jhapa) in the low lands of the eastern region of Nepal. Health-related data on malaria and diarrhoea were taken from the health management information system of the Department of Health Services for the ten-year period. The data on climatic variables were collected from the Department of Hydrology and Meteorology. Access was difficult to the non-climatic data; hence, it was not incorporated in the research study. Standard analysis of climate change and human health could not be done by holding non-climatic factors constant. Therefore, the analysis was done using time-series correlations. The tests of significance were applied wherever applicable.

The diarrhoeal disease in Jhapa district has been increasing since 2006. The monthly distribution of diarrhoeal diseases showed an increase in the number of cases from April to September. The cases of malaria showed an increase in the years 2002 and 2005, which may be due to the occurrence of an outbreak. The monthly malaria cases were very high during the monsoon season. The average temperature in this district was around 25°C in the past ten-year period. Monthly variation occurred every year. The seasonal temperature variation shows the highest temperature in the monsoons and the lowest in the winters. The monthly range of rainfall was very high in the month of July. Monsoon contributed about 80% of the rainfall in this region. The monthly variation of relative humidity showed the highest relative humidity in the summer and winter seasons. The maximum temperature had risen by 0.05 or 0.06 degrees Celsius in the ten-year period whereas the minimum temperature had risen by 0.01 degree Celsius per year. The rainfall had been decreasing by 7.1 mm per year, and there was also change in humidity.

Trend analysis was done to show whether the cases of malaria and diarrhoea were decreasing or increasing with change in temperature. The trend of malaria cases and maximum temperature showed that, with a minimum change in temperature, the number of cases increased, but it does not mean that the rise in temperature was responsible for increased malaria cases, because there were so many other factors like the health system and population growth and the malaria control programme itself, which were affecting the increase in the number of cases. Hence, one cannot directly ascribe the

increase in temperature to the increase in the number of malaria cases. Similarly, low temperature also showed an increased number of malaria cases, though there was very minimal change in the minimum temperatures (Fig. 1). There was a drastic decrease in the annual rainfall but the number of malaria cases increased. Similarly, the number of diarrhoea cases was on the increase while the change in temperature was minimal. Even for humidity, the observation was the same, i.e. the number of cases increased, while there was minimal change in the humidity level. The rainfall was decreasing but the cases were increasing (Fig. 2).

Fig. 1: Relationship between minimum temperature and malaria, Jhapa district, Nepal

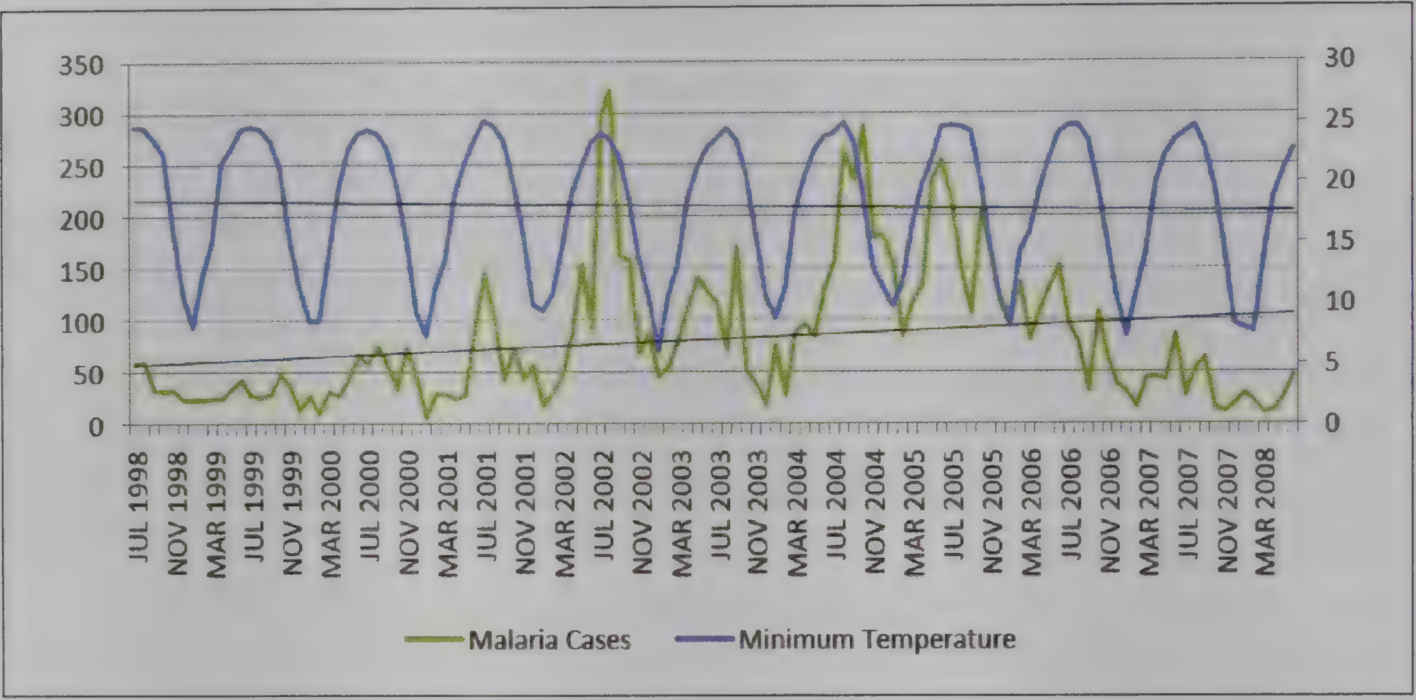
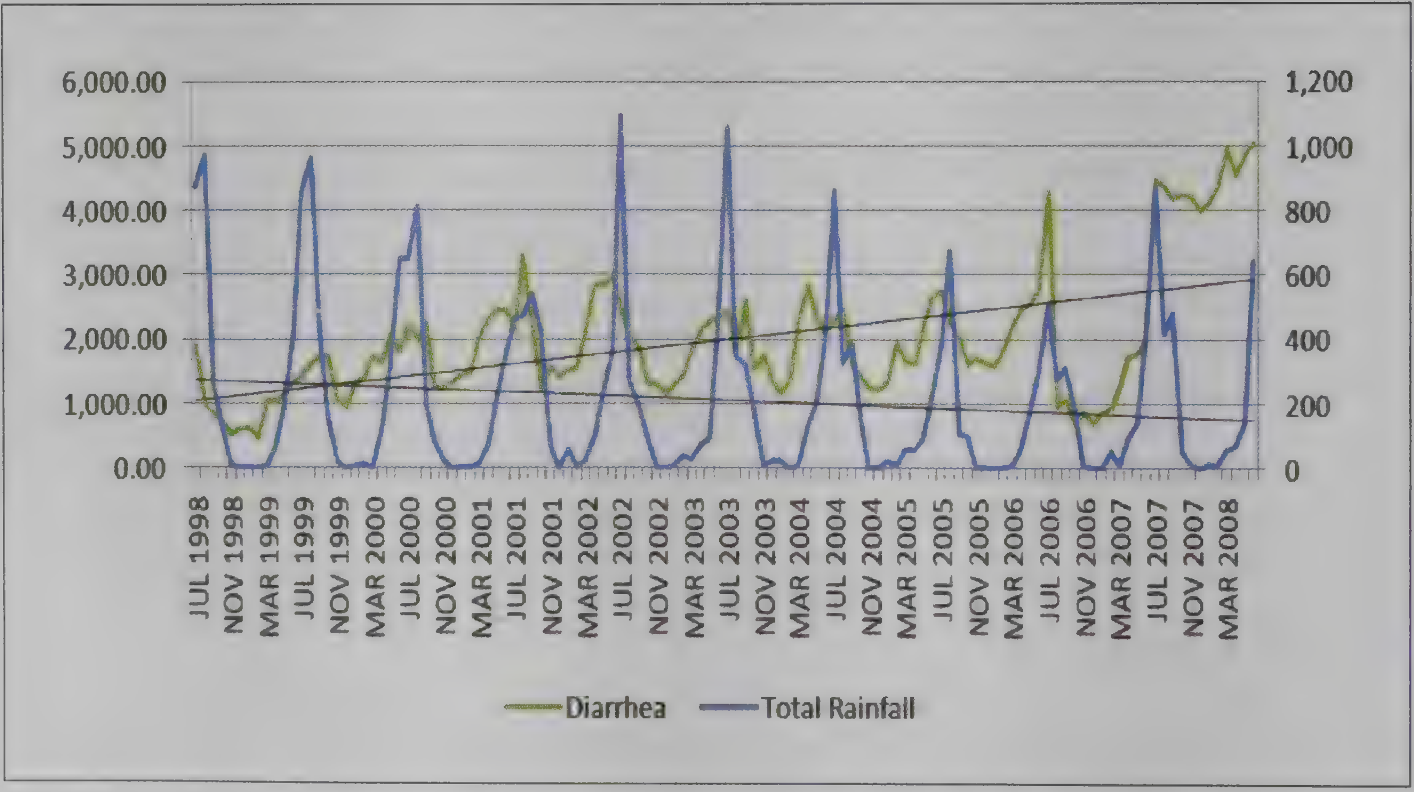


Fig. 2: Relationship between total rainfall and diarrhoea, Jhapa district, Nepal



The temperature and rainfall had a correlation with the number of cases of diarrhoea and malaria, but in the time-series analysis, none of these were significant predictors of malaria and diarrhoea. Access to the data for non-climatic factors, such as population size, immunization coverage and the malaria control programme, was difficult. It was not possible to incorporate this information in a monthly data format. Other non-climatic data like water supply, sanitation and hygiene were also not available due to lack of a reporting system. Actually, none in the villages of the district had data on piped water supply, sanitation and hygiene.

The conclusion of the study was that there was only a minimum change in climate from 1999 to 2008 but there was an increase in the number of malaria and diarrhoea cases during the same period. There was a positive correlation between the maximum-minimum temperatures, rainfall and occurrence of diarrhoea and malaria with statistical significance (Tables 1 & 2). In the time-series analysis, none of the climatic variables was found to be a significant predictor of malaria and diarrhoea.

Table 1: Correlation between climatic variables and malaria, Jhapa district, Nepal

Climate variables	Pearson correlation	*p*-value
Maximum temperature	.284	.002
Minimum temperature	.338	<.001
Relative humidity (AM)	.065	.4
Relative humidity (PM)	.076	.4
Rainfall	.202	.03

Table 2: Correlation between climatic variables and diarrhoea, Jhapa district, Nepal

Climate variables	Pearson correlation	*p*-value
Maximum temperature	.268	.003
Minimum temperature	.263	.004
Relative humidity (AM)	.079	.3
Relative humidity (PM)	.033	.7
Rainfall	.230	.01

A major limitation of the study was that only one district was selected from the low lands of Nepal. The change in climate is more in the hilly and mountainous areas of the country. The analysis could not include secondary data on the non-climatic factors. It is recommended that a prospective study should be carried out in the three ecological regions of Nepal by including primary data for water, sanitation and disease control programme(s) as also the non-climatic variables like sociocultural factors and other factors related to the health system. There is a need for instituting training programmes for epidemiologists and biostatisticians at the government level.

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Parallel Session 7

Pandemic (H1N1) Influenza: update in the Region

Chairpersons: *Keiji Fukuda*

Session Coordinator: *Shalini Pooransingh*

The role of influenza surveillance systems in the H1N1 response, Bangladesh
– *Mahmudur Rahman*

Pandemic influenza A H1N1: preparedness and response in India – *Shashi Khare, Arvind Rai, D. S. Rawat, Ramesh Aggarwal and Archana Choudhry*

Preparing Indonesia for the Pandemic Influenza – *Nyoman Kandun & N Kumara Rai*

Thailand's response to H1N1
– *Supamit Chunsuttivat*

What pandemic activities should countries focus on now? – *Keiji Fukuda*

The role of influenza surveillance system in H1N1 response, Bangladesh

Mahmudur Rahman

There are several disease reporting systems in Bangladesh. Most of these rely on aggregate counts compiled at the district level by the district statistician. The district statistician regularly receives data from each Upazila Health Complex, where the data are compiled by the upazila's statistician. These data include information about inpatients and outpatients, as well as data provided by community workers.

Recently, a web based priority communicable disease surveillance has been added. Since July 2009, all 64 districts are connected to web to report directly. There is a plan to link this system down to the sub district level also. Surveillance for outbreak investigation, called event based surveillance, has started a 24 hour hot line to which any health institution can report any time. Newspaper scanning is done and TV news is also followed. Institutional disease surveillance and sentinel surveillance also exist. Special disease surveillance has been set up in the last few years such as Nipah surveillance. Acute encephalitis surveillance was started in 2007 and now the Japanese encephalitis and meningococcal meningitis has been included in the special surveillance. A laboratory has been set up with support from US CDC.

Community based influenza surveillance was started in 2004 in Dhaka city. This is a collaborative activity between ICCDR,B with the support of CDC. Avian influenza surveillance has been done in high risk groups, i.e., among persons who are involved in the culling process. Whenever there is an infection in the poultry sector, line listing of the cases and follow up is done for 14 days. This is also a web based surveillance system. From people reporting influenza like illness (ILI) samples are collected to do the testing in Dhaka city corporation area. In the capital city, 20 markets are followed on a weekly basis. NGOs providing service delivery in these areas also send information. Recently community based surveillance has been started. Thirty outbreak investigations were carried out in 2008. First human case of Avian Influenza was identified in Bangladesh from the community based surveillance system in Dhaka city. Human cases of chickungunya were also identified in the northern district of Bangladesh. In 2009, a number of out break investigations were carried out. As of 8th March 2010, 841 confirmed cases of H1N1 have been reported. Cholera and anthrax outbreaks were recorded. This year there were more outbreak reports on pneumonia, nipah, chickenpox and jaundice.

The hospital based surveillance was started in 12 centres in 2007 which is being expanded to 14 more centres. Hospital based influenza surveillance has two objectives: to identify individuals and clusters of people who have life threatening infections with influenza virus and to characterize the diversity of influenza circulating in Bangladesh. These centres have been distributed throughout the country homogenously covering all the six divisions (Fig. 1). There are six government and six private hospitals because lot of people go to private hospitals. In these hospitals, about 200-1000 patients visit per day, and inpatients beds range from 250 to 1000. In each hospital there is a trained surveillance physician who works in the hospital. They visit in-patient everyday and identify the cases, collect throat and nasal swab and look for the clusters. The surveillance physician, two days in a month, go to the outdoor and identify up to twenty ILI patients and collect their throat and nasal swabs. These samples are brought to the national level laboratories for the RT-PCR.

Fig. 1: Participating institutes of Hospital based influenza surveillance in Bangladesh

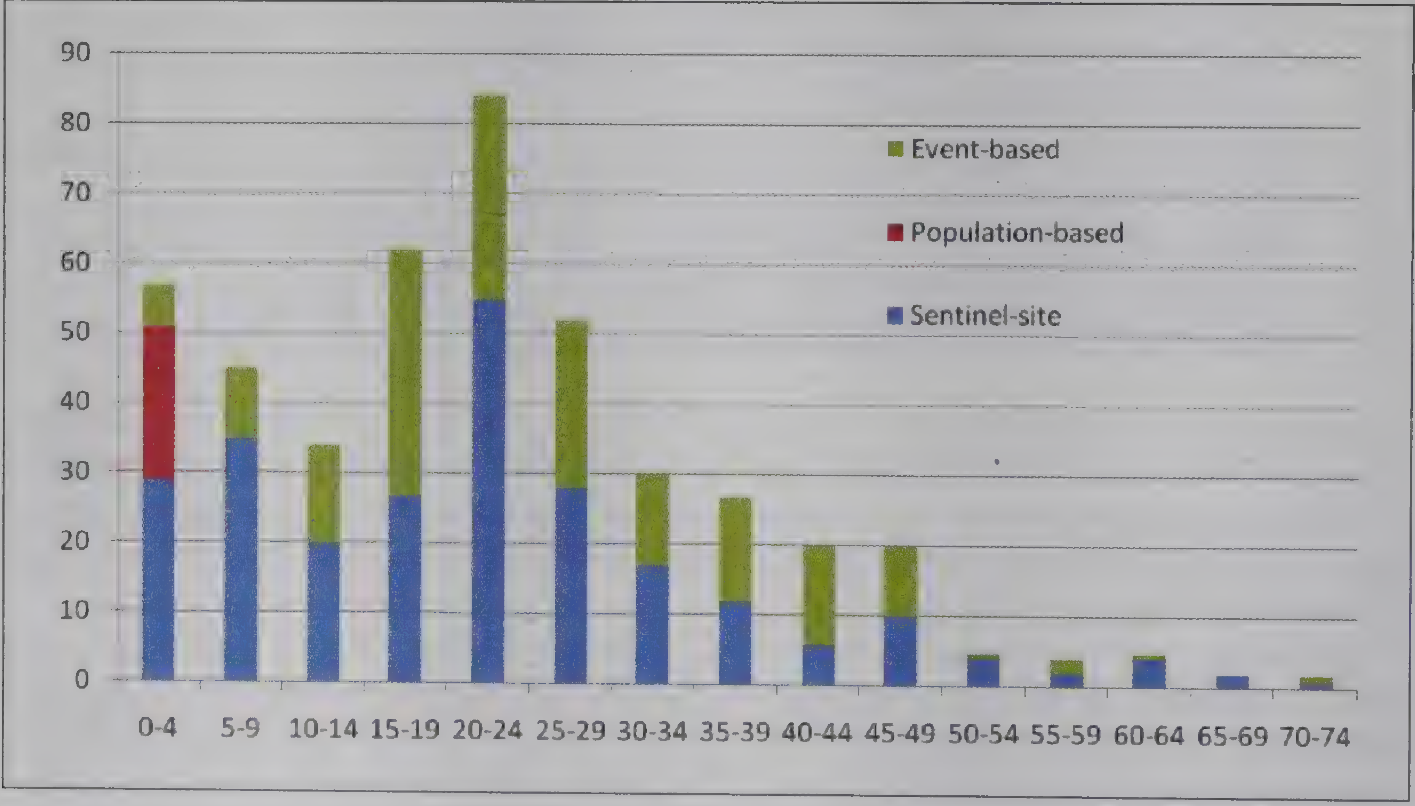
A total of 7257 samples have been collected up to January 2010, of which 12% were positive for influenza. Of the positive about 73% are influenza A and 27% Influenza B. Of the influenza A, in the Pandemic, HINI was isolated in 31% in all the surveillance sites (table 1). Though there were 12 hospital sites, but during the pandemic period more than 20 sites were opened up from where samples were collected in the city areas.

Influenza in the last few years started from April until September but 2009 was different. The pandemic influenza H1N1 peaked in September and October 2009 but winter season was not a problem. Some cases came up in March 2010 also. Avian influenza in the poultry peaked in February to March but the peak for pandemic influenza was in the different season. So they did not come together, hence the chances of re-assortment was little less. Lower age group was affected more than the higher age group in different surveillance sites, i.e., in event based surveillance, population based surveillance and sentinel sites (Fig. 2).

Table 1: Identification of types and subtypes of Influenza from samples collected between May 2007 and January 2010 from Hospital based Influenza Surveillance in Bangladesh

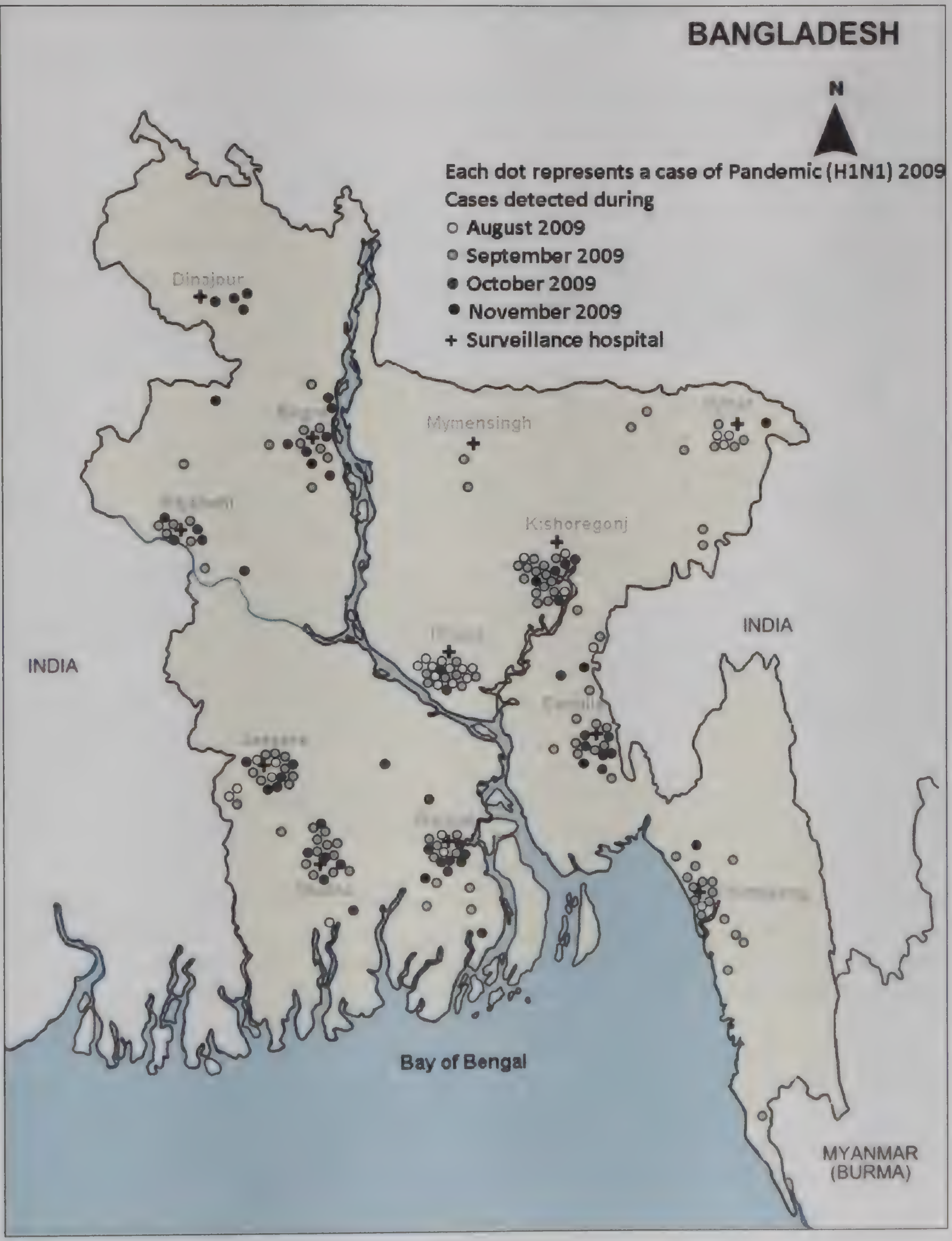
Sample positivity	Influenza Like Illness
Sample collected	7257
Influenza positive	851 (12%)
Influenza types	
Influenza A	620 (73%)
Influenza B	231 (27%)
Influenza subtypes	
Influenza A H1	137 (22%)
Influenza A H3	287 (46%)
Influenza A H5	0 (0%)
Pandemic A H1N1	194 (31%)

Fig. 2: Distribution of Pandemic influenza H1N1 by age



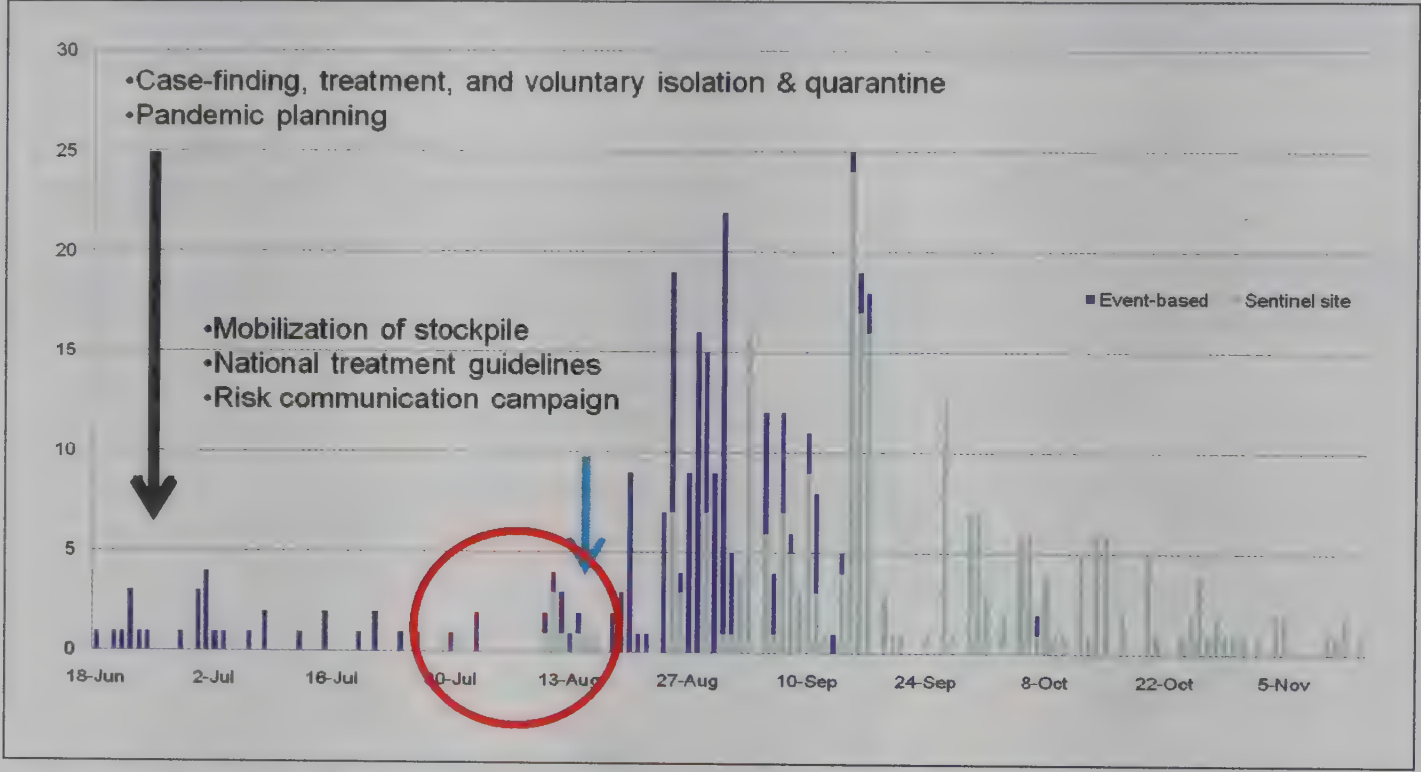
From the event based surveillance, first case was recorded on 18th of June 2009 in Bangladesh. Then it started appearing in the community based surveillance, and also in the sentinel sites outside the city corporation area (Fig. 3). It meant that the infection had got into the community. Finally, H1N1 showed up in all sentinel sites. Testing for the general population was stopped because it would not be possible to take care of testing and giving treatment.

Fig. 3: Distribution of patients infected with 2009 pandemic influenza A (H1N1) virus during June-November, 2009—Bangladesh



For the case management, the country was divided into level 0, 1, 2, and 3. When the number of cases had gone into the community, it was categorized as level 3. It was the level when there was no need to go for testing but presumptive treatment was to be given. That decision helped a lot in reducing the burden on the laboratory. Concentration was shifted on surveillance rather than on identifying individual cases. In the central sentinel sites H1N1 gradually spread during August to November (Fig. 4).

Fig. 4: Patients infected with 2009 pandemic influenza A (H1N1) virus by platform June-November, 2009—Bangladesh



The early warning of community transmission helped to make decisions and also to train people. For Avian influenza, a large number of people were trained particularly the abettor members, which helped a lot in containment of the disease. From the beginning, the event based surveillance was aggressively used. Whenever a case was identified, a contact case tracing was done. Sixteen points of entries within the country were screened. There are mixed experience about entry from different countries but Bangladesh benefited as it slowed down the transmission a little bit as initially cases were coming from outside the country. They were tracked down and followed up for 10 days. Though WHO recommendation was seven days home isolation, but Bangladesh advised people to stay at home for ten days that also gave some breathing time.

Identifying and characterizing emerging diseases with dedication and hard work, interest from collaborating hospitals, bringing public and private institutions together into one surveillance system, building capacity of the institutions, training and infrastructure, all worked, in the field, together, took a decision together, that was the strength. The backbone was the surveillance data which helped in decision making.

Pandemic infuenza A H1N1: preparedness and response in India

Shashi Khare, Arvind Rai, D.S. Rawat, Ramesh Aggarwal and Archana Choudhry

Influenza (flu) pandemics are caused by new influenza viruses that have recently adapted to humans and resemble major natural disasters, both in terms of recurrence and magnitude. The influenza virus, known to be circulating as a pathogen in the human population since at least the 16th century, is notable for its unique ability to cause recurrent epidemics and global pandemics. An influenza pandemic is an epidemic of an influenza virus that spreads on a worldwide scale and infects a large proportion of the human population. Novel H1N1, a new influenza virus that is causing illness in people, was first detected in the United States in April 2009.

In India, out of the 35 states and Union territories, 31 are reporting cases and deaths due to H1N1. India is a very large country with an area of 3 287 263 km^2 and a population of 1.17 billion, divided into 28 states and 7 Union territories, 623 districts, 638 588 villages, 5161 towns and 5470 subdistricts. Novel Influenza A H1N1 was first reported in India in May 2009. A total of 29 652 cases and 1372 deaths have been reported till march 2010. The maximum number of cases were reported from Delhi, Maharashtra, Gujarat, Rajasthan, Karnataka and Kerala. High incidence of H1N1-positive cases occurred from August to October 2009 in the age group of 5-19 years. Monitoring and screening of influenza-like illness (ILI) cases was done in all the states to identify early warning signals and to do case detection. India has been able to contain and manage the pandemic through preparedness and response, rapid diagnostic development, vaccine policy, drug-resistance monitoring, molecular epidemiology, characterization of host response, evaluating transmission and epidemiology / surveillance.

Based on WHO guidelines, India has formulated its own strategies for the containment of pandemic influenza which were used to minimize economic loss, do early detection, containment and control of avian influenza and prevent its transmission to humans. These strategies also helped in preventing or slowing the entry of a novel strain of human influenza into the country. They also help to minimize illness and deaths.

The elements for successful control of the pandemic in India included the health system's preparedness, surge capacity for early detection, case management, coordination, command and control for assessment of risk, scaling up of effective and timely interventions, transparency and timely information-dissemination by an alert electronic media, health care providers, public, etc. Use was made of interventions that were proven, applicable and less disruptive as public health measures; for example, information on simple, effective practices, school closure in affected localities with a health education message, adaptation of measures based on context and need, restriction of mass gatherings, and intensive information, education and communication (IEC) activities.

Response by Government of India

The National Centre for Disease Control (NCDC) has been declared as the nodal agency to support the containment, prevention and control of influenza A H1N1. It took the following actions:

Early detection, investigation and containment

Entry screening was instituted at 22 international airports for all passengers. Eleven governmenthospitals and some private hospitals were designated for isolation and management of suspected and confirmed cases. Isolation facilities in different parts of the country were upgraded. Infection control practices in all identified health care facilities were strengthened. Apart from the measures taken for early detection of H1N1 cases, the early and timely administration of tamiflu to all confirmed cases and there H1N1 contacts helped in containment of the infection.

Stockpiling of antiviral drugs, PPE, N-95 and TLM

Adequate stockpiling of PPE, VTM, N-95, triple-layered mask (TLM) and tamiflu tablets, as well as syrupfor paediatric patients, was done and 19 Regional Directors were nominated in different states to meet any emergency situations. All the state surveillance units of the Integrated Disease Surveillance Project (IDSP) had a stockpile of good-quality viral transport media for their districts.

Preparation of guidelines and SOPs

NCDC assisted the Ministry of Health and Family Welfare (MoH&FW) in the preparation of guidelines and standard operating procedures (SOPs) on different issues regarding H1N1, including laboratory investigations, sample collection and transportation, waste management, school health guidelines, self-health assessment, CD-Alert , dos and don'ts, travel advisory and airport screening proforma.

Training and equipping of Rapid Response Team (RRTs)

Training was conducted by MOH & FW,GOI for state and district Rapid Response Teams (RRTs), private doctors through the Indian Medical Association and IDSP nodal officers. Clinicians, private practitioners and microbiologists were guided on sample collection by NCDC MOHFW GOI.

Management of cases and increasing awareness

A 24X7 helpline was developed to increase awareness among community and healthcare workers.

Information, education and communication material on H1N1 was prepared in 16 languages withsupport from UNICEF and WHO. Individual, group and mass education programmes were conducted on a regular basis during the pandemic.

Avian influenza laboratory network

Initially, only two laboratories were identified for the testing of H1N1 samples (NCDC, Delhi, andNational Institute of Virology, Pune). Now, 44 laboratories are performing tests for H1N1 across the country. During the pandemic, the national laboratory network was managed by the central laboratory at NCDC. Maintenance of laboratory capabilities (facilities, equipment and reagents) across the country was managed by the central laboratory. Quality control of the diagnostic capability of all the laboratories was assessed by the central laboratory. Regulations for biosafety, and containment

of pathogens , quality control , maintenance of capacity to produce data and oversee flow of data for all the labs under lab network were also outlined by NCDC. Linkages with the WHO focal point and international networks and participation in the national surveillance system were established.

Contact tracing under IDSP

Contact tracing was done through the state units ofIDSP. A self-help monitoring proforma wasdeveloped for contact tracing, which was used widely.

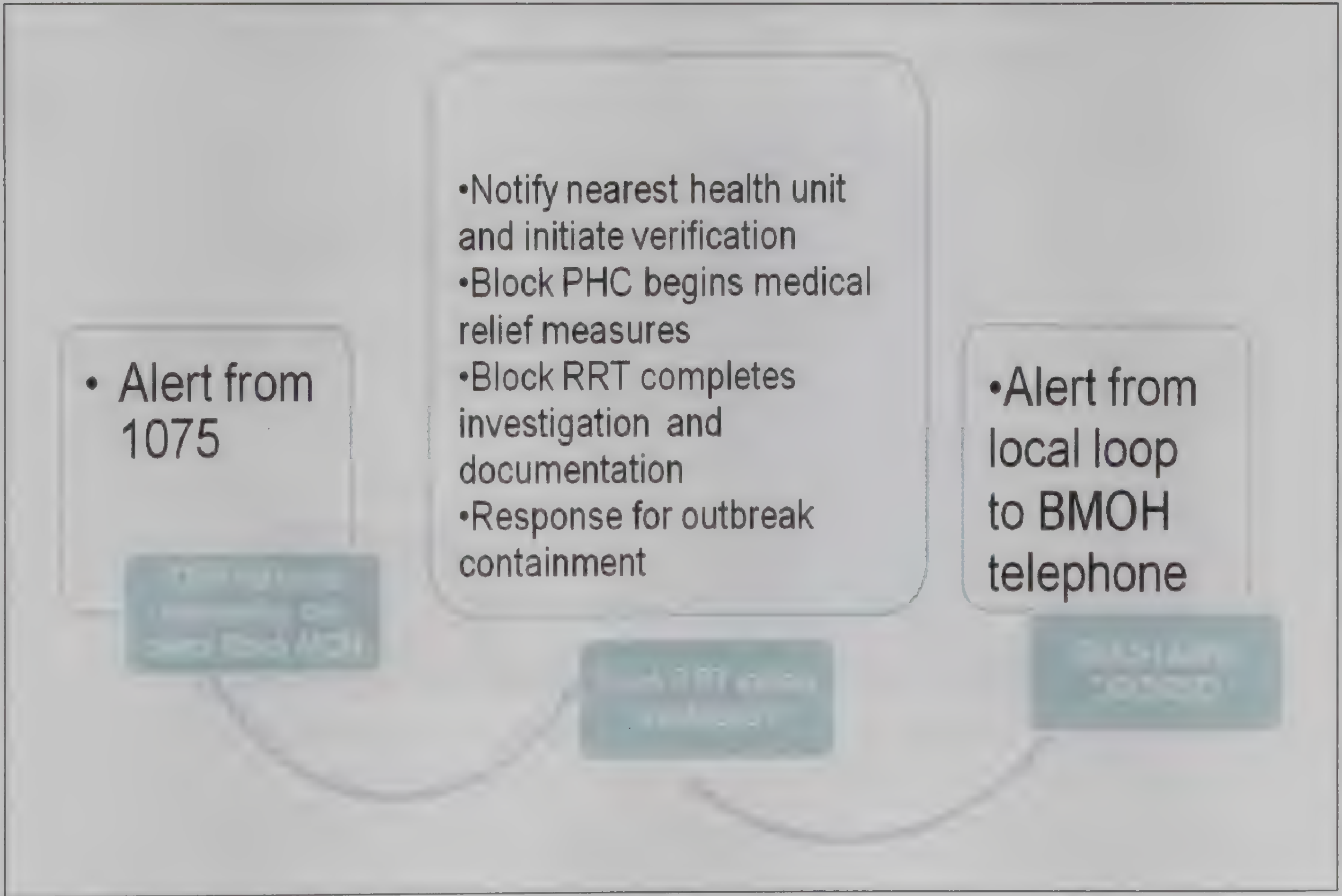
Enhanced surveillance

All states were alerted to heighten the level of ILI surveillance. Immediate reporting of clusters ofILI and that of pneumonia through IDSP state units was initiated. Central and state rapid response teams were formed for investigation and management of suspected outbreaks. Medical practitioners were sensitized through print media to report any cluster of Influenza Like I llnessto a toll-free telephone number or the outbreak monitoring cell in NCDC, Delhi (Fig.1).

Route for action on alert through IDSP call centre

During the outbreak, a 24X7 call centre and a toll-free number were functional to receive any alerts regarding H1N1 in the country. Total 36918 number of calls were received by this alert system .

Fig.1: Surveillance alerts about influenza-like illness



BMOH : Block Medical Officer of Health

Fig. 2: Age- and sex-wise positive cases of H1N1 influenza from 1 May 2009 to 14 February 2010 at NCDC, India

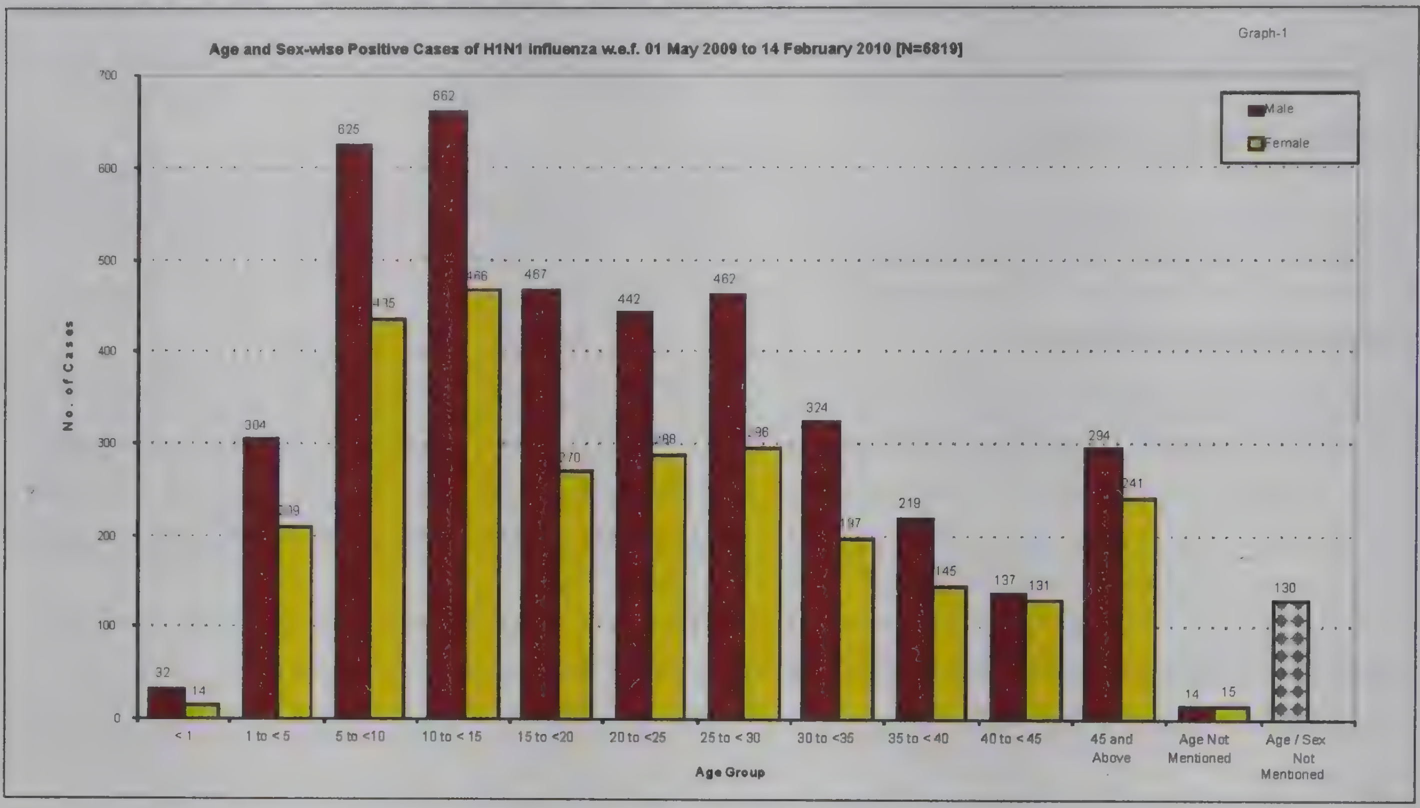


Fig. 3: Positivity of H1N1 cases at NCDC, India, as on 3 March 2010

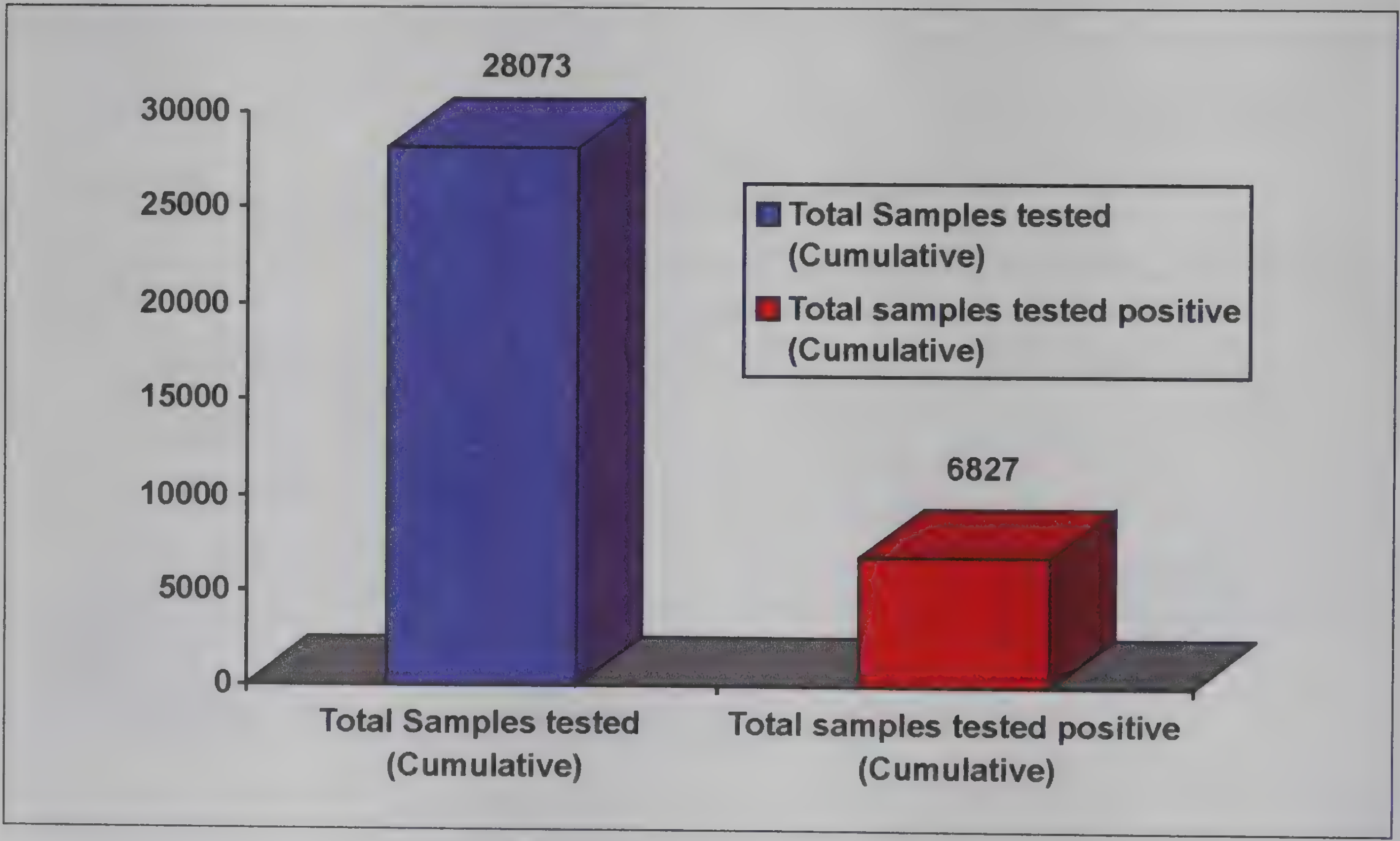
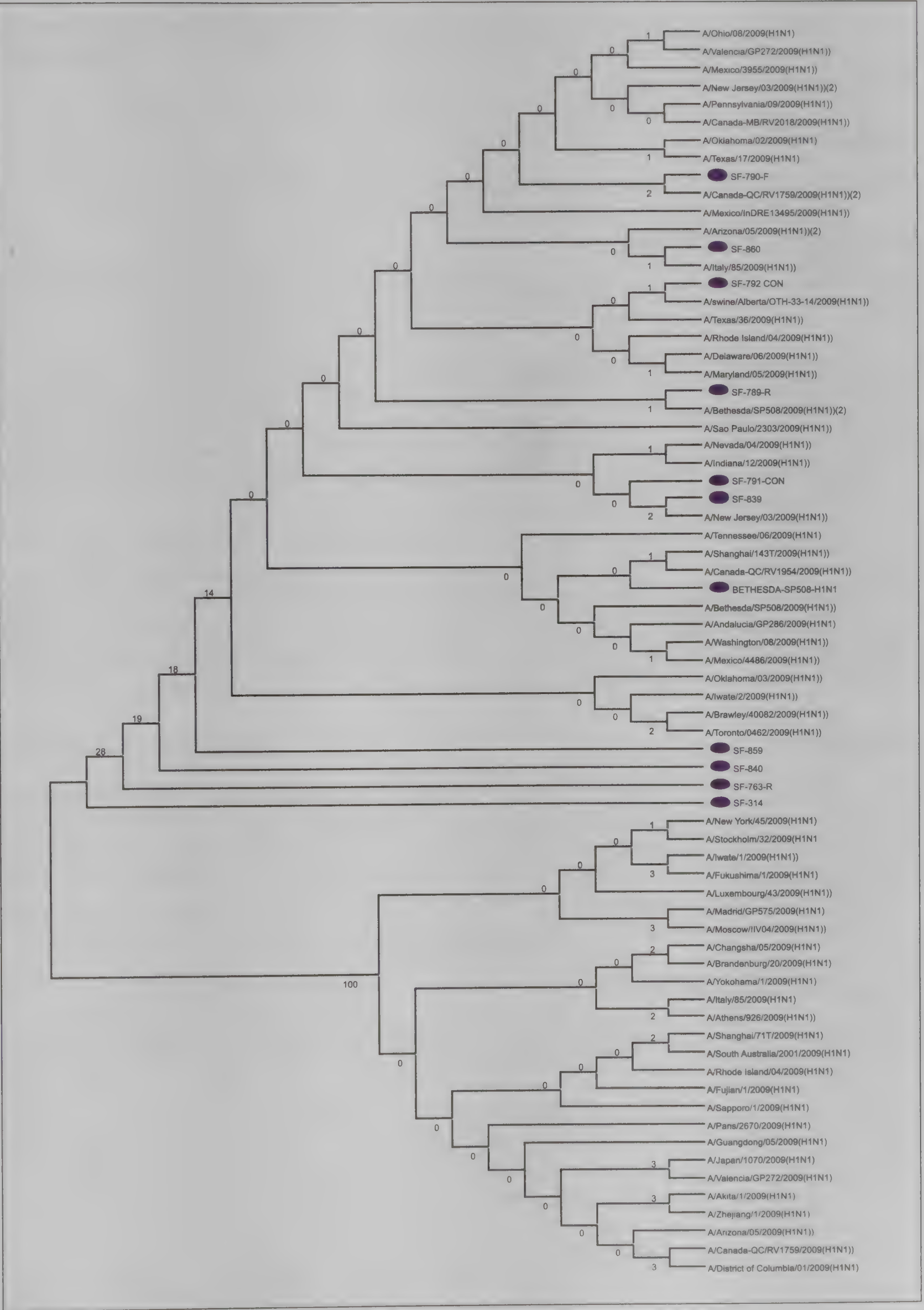


Fig. 4: Evolutionary pattern based on sequence analysis



Involvement of other sectors

A multisectoral approach was adopted to control the pandemic in which various agencies likeEmergency Medical Relief, Department of Animal Husbandry, Dairying and Fisheries and the National Disaster Management Board were involved.

Vaccine policy

The Government of India is procuring vaccine for use among health care workers.

Drug-resistance monitoring

India is monitoring drug resistance on a regular basis but no drug resistance has been reported till date.

H1N1 epidemic situation in India

In India, 29 652 laboratory-confirmed cases of H1N1 and 1372 deaths have been reported so far. NCDC had tested 28037 samples till 3 March 2010, of which 6827 were positive for influenza AH1N1. Testing of ILI cases was done only for severe cases, i.e. category C severe cases admitted to hospitals, so the data does not represent the entire population.

An analysis done according to age- and sex-wise distribution of H1N1-positive cases tested atNCDC revealed that the majority of cases occurred in the 10-15-years age group, and males were affected more than females, as shown in Fig. 2. The samples tested at NCDC revealed that out of the total 28073 samples tested till February 2010, 6827 were positive for H1N1, showing a positivity rate of 24.3% as shown in Fig. 3 . Fig. 4 shows the phylogenetic analysis of the test samples with A/ California/04/2009 virus using Neighbour Joining method in MEGA 4.1 Software.

Conclusion

In India, the H1N1 disease is on the decline and regular monitoring and surveillance of unusual flu like illness and severe pneumonia are being continued across the country. Regular and continuous surveillance will facilitate timely detection of pandemic virus and implementation of control measures. This pandemic has given an opportunity to strengthen national surveillance and build core capacities in accordance with the International Health Regulations. This has also provided the country a unique opportunity to be ready for any future pandemics of influenza A.

Acknowledgement

We are grateful to all staff members of the Microbiology Division and Disease outbreak Monitoring Cell , NCDC, Delhi.

Preparing Indonesia for pandemic influenza

I Nyoman Kandun and Nyoman Kumara Rai

Over the last 100 years, the incidence of influenza in Indonesia has been studied through a variety of surveys and sentinel surveillance activities *(1,2)*. Influenza is not a nationally notifiable disease in Indonesia, as it is generally perceived to be a mild self-limiting illness among the general public and, to some extent, by the medical profession as well.

Although there is limited information available about the relative importance of influenza in contributing to epidemic and sporadic disease, understanding the epidemiology of influenza viruses is important to document the potential burden of the disease, compared with that of other respiratory illnesses such as bacterial pneumonia *(3)*. Surveillance activities can provide useful baseline data for measuring local epidemics and can generate critical information regarding the circulating strains that could have an impact on the annual selection of appropriate vaccine strains. This is especially important to aid in the use of vaccines for the target population of yearly hajj pilgrims from Indonesia to Saudi Arabia *(4,5)*.

Influenza surveillance

The National Institutes of Health Research and Development (NIHRD) started to conduct influenza surveys in 1975 *(2)*. The surveys stopped and re-started several times as influenza was not perceived to be a priority, but were re-started in 1999. The aim of the surveys was to estimate the burden of influenza in the country.

Specifically, the objectives were:

- To identify the characteristics of influenza-like illness (ILI) cases;
- To identify the types and subtypes of the influenza virus in Indonesia;
- To form a national influenza network.

The surveys are conducted in 48 sites comprising both hospitals and health care centres in a total of 22 provinces *(1)*. Even though these surveys do not cover or fully represent the entire Indonesian population, they offer an opportunity to assess within-country variation in disease trends. This is especially important for a country of Indonesia's geographical expanse and population size. The survey findings suggest that influenza viruses circulate throughout the year. Between 2006 and 2008, there was a high prevalence of influenza A in the rainy season (December to February) and flu B had a consistent low prevalence throughout the year. During these surveys, influenza was detected in 20% of ILI cases where approximately 4000 entered the survey population each year. Future surveys will need to relate laboratory results with clinical outcomes as well as understand the age distribution and other demographic characteristics of those infected.

Avian influenza A H5N1

Avian influenza A H5N1 (AI H5N1) outbreaks in poultry were first identified in August 2003 *(6)*. Within two years, the disease had spread to 23 provinces covering 151 districts/cities causing over 10 million bird deaths. Since then, 31 out of 33 provinces (93.9%) have reported outbreaks and the first confirmed human H5N1 case in Indonesia occurred in June 2005 *(7,8)*.

The first human case was part of a cluster which included two confirmed cases and one probable case among five family members living together in a suburb west of Jakarta *(9)*. By December 2009, there were 161 laboratory-confirmed cases with 134 deaths (case-fatality rate 83.2%) in 13 provinces, 51 districts/municipalities and 110 subdistricts. The highest number of cases was found in Jakarta province (43), West Java province (40) and Banten (30) *(10)*.

The government embarked on a series of control measures which were encapsulated in 10 basic strategies in the national strategic plan for H5N1 influenza control: 1) control in animals; 2) case management; 3) protection of high-risk groups; 4) integrated surveillance; 5) restructuring of the poultry industry; 6) risk communication, education and public awareness; 7) law regulation and enforcement; 8) capacity building; 9) research and development; and 10) monitoring and evaluation *(11)*. Overall, these strategies were aligned with international guidance that emphasized controlling zoonotic diseases 'at source'.

The National Strategic Plan for AI H5N1 Control and Pandemic Influenza Preparedness 2006-2008 was issued in December 2005 *(12)*. However, due to limitations in the public health resources in the initial phases of the plan, greater emphasis was placed on activities to control the disease in animals, human case management, risk communications and integrated surveillance. By March 2007, a National Committee for AI H5N1 Control and Pandemic Influenza Preparedness was established which was headed by the Coordinating Minister for People's Welfare.

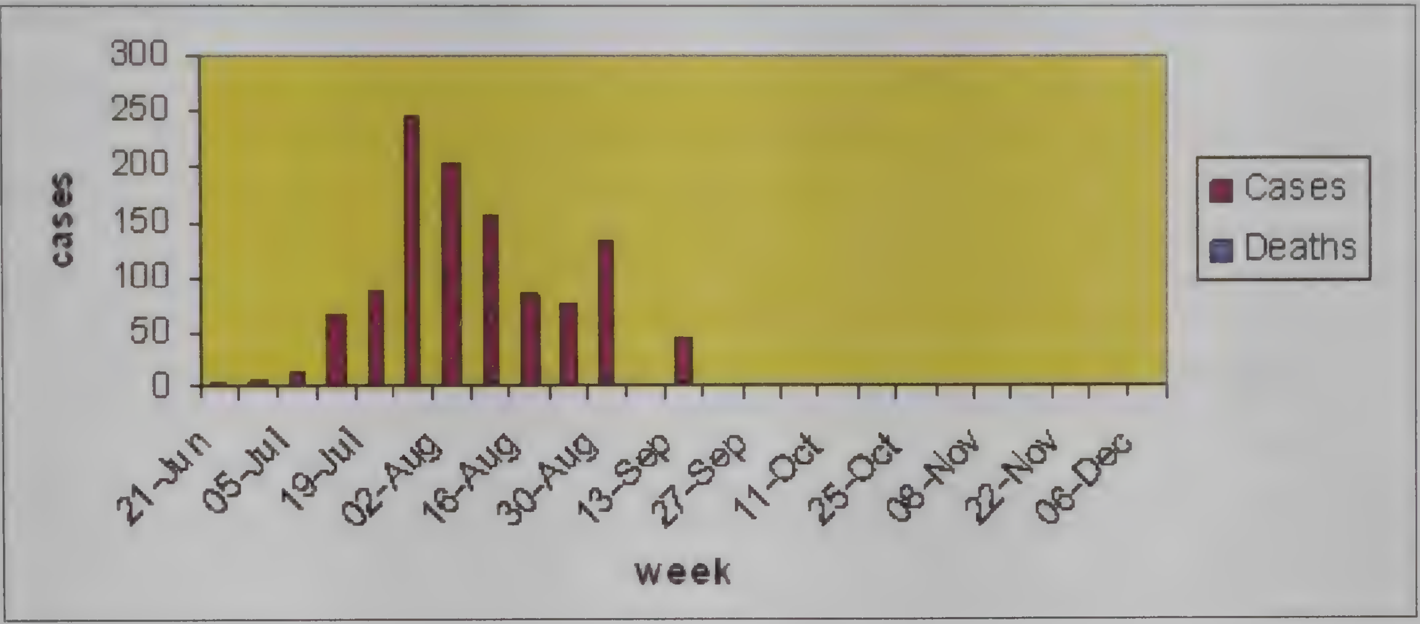
The control of AI H5N1 in birds and the preparedness for events that signal sustained transmission between humans continues. Indonesia has conducted two full field simulations of an epicentre containment following the development of specific guidelines to control an initial human cluster of influenza that signals the spread of a new virus.

Pandemic H1N1

The first cases of pandemic H1N1 were identified in July 2009 in Indonesia (Fig.). By September 2009, 1098 cases with 10 deaths were detected through the hospital network. Cases were detected in 25 of the 33 provinces and the maximum number was detected during the first two weeks of August. The case demographics show a similar rate of infection in males and females, and the majority of infections occurred in the 11-25-year-old age group. Since the initial phase of the pandemic focused on international travel and imported cases, Indonesia maintained border surveillance at both sea and air ports. Of the 1098 cases identified, 6% were foreign nationals and 13% had travel history to affected countries.

The impact of the pandemic has not been fully assessed but the impact on the health system during the first wave was assessed as moderate (according to the World Health Organization's classification system). Even though there was wide coverage of the pandemic in the media, the social impact was not considered as substantial. Some school closures were initiated by local authorities but other mass gatherings continued unaltered. As of end-February 2010, the situation in Indonesia suggests localized geographical spread with decreasing activity and low-level intensity and impact.

Fig.: Weekly Pandemic (H1N1) 2009 Cases and Deaths
Indonesia



Conclusions

Indonesia currently allocates limited resources to the general surveillance and response to influenza work due to other public health priorities. The disease burden is known through small surveys and limited surveillance that suggests circulation of the virus throughout the year. Due to the global emergency associated with AI H5N1 and the need for pandemic influenza preparedness, additional resources enabled the development of pandemic preparedness plans, enhanced capacity in diagnostics, case management and outbreak response. These activities aided in the response to H1N1.

Based on past experiences and the indication that all the ingredients for the creation of new influenza viruses with pandemic potential are present, there is no doubt that there will be an influenza pandemic in the near future; it is just a matter of time when and where the pandemic will occur. The only answer is to remain prepared.

Future activities for influenza need to emphasize better characterization of the disease epidemiology and vaccine strategy, and to monitor the AI H5N1 situation that may still trigger a new influenza pandemic.

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Thailand's response to influenza A H1N1

Supamit Chunsuttiwat

In Thailand, the first cases of influenza A H1N1 were presumably imported into Bangkok from North America in the first week of May 2009. Very quickly, the number of cases increased. The outbreak peaked by end-July. The first lesson was that the H1N1 pandemic influenza spread very fast - like wildfire. The first wave has passed, and it seems Thailand is now in the middle of the second wave. It appears that the second wave would be smaller than the first one. However, the situation will be evaluated based upon the existing surveillance system.

The first wave of H1N1 started with a brief period of introduction of cases from abroad, followed by a very brief period of about a month of local transmission, and then the outbreak spread far and wide. Within the local transmission, schools served as the main source of outbreak (Fig. 1). In summary, the first wave lasted from May to October 2009. It has been estimated that about 13% of the population was affected. This might be a minimum or conservative estimation. A little more than 25 000 cases were confirmed, and with 180 deaths reported, the case-fatality rate was less than 1% among the confirmed cases (Fig. 2).

Fig. 1: Distribution of confirmed influenza A (H1N1) cases by district in Thailand at week 30th, 2009 (Late July)

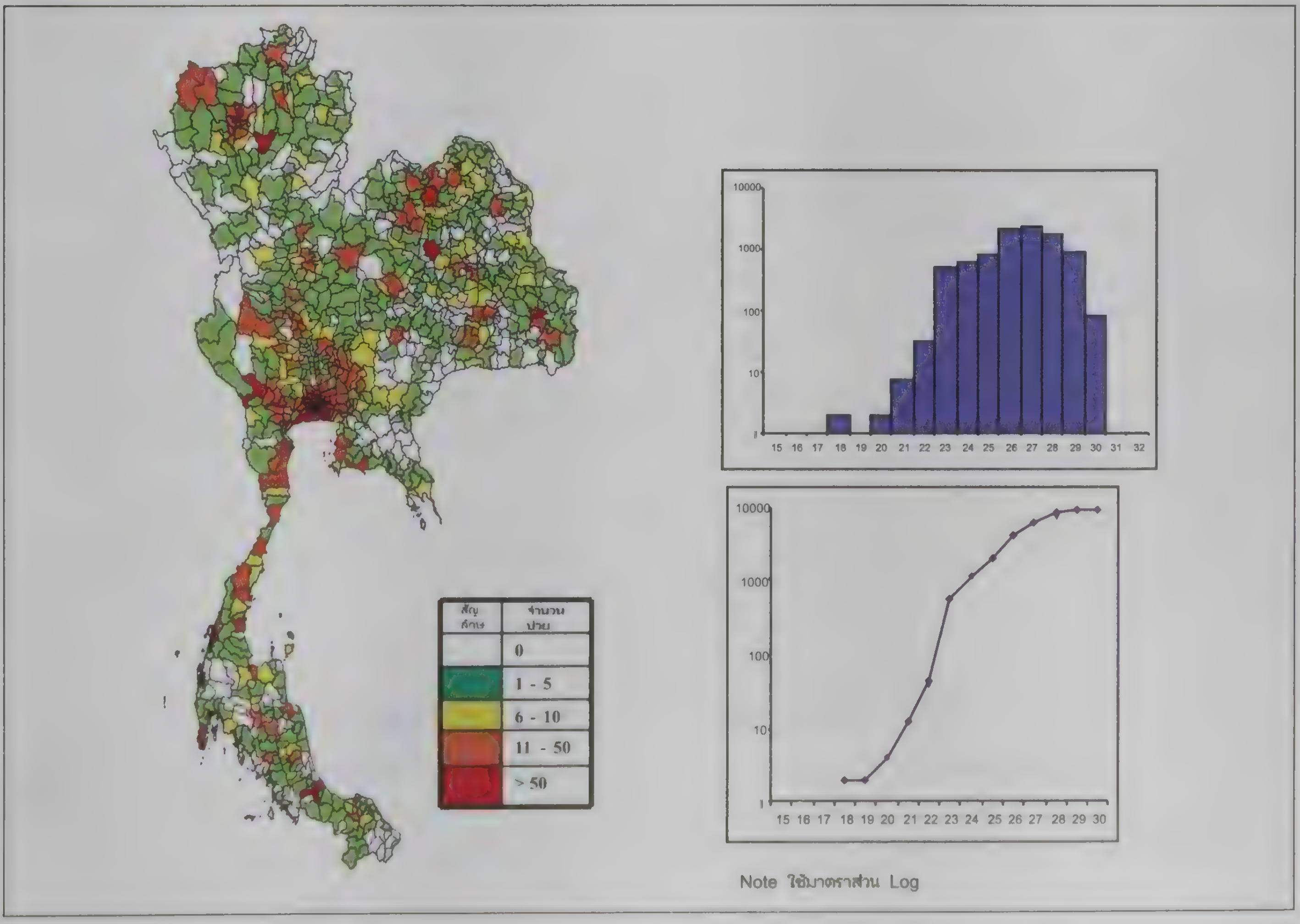
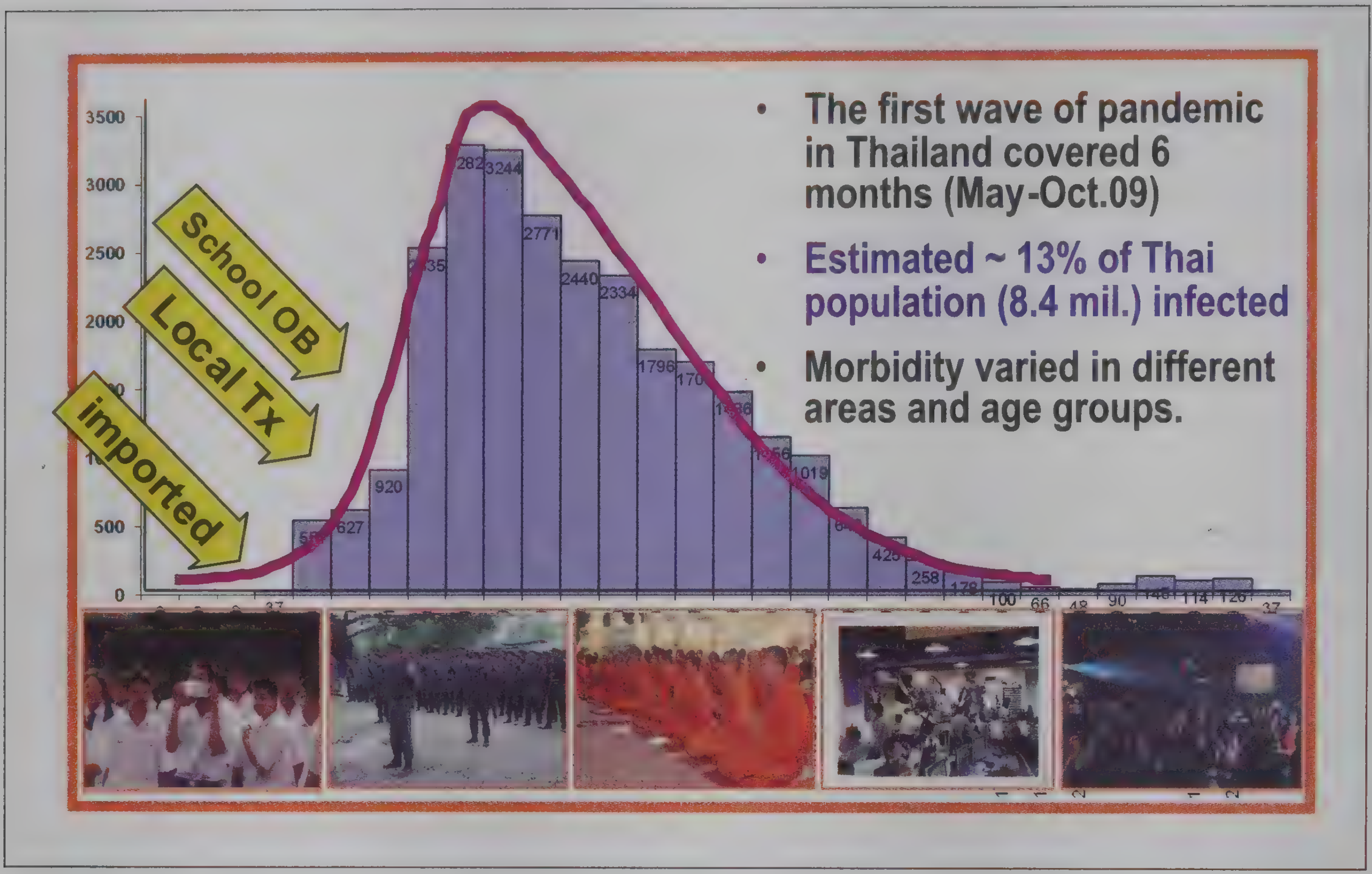


Fig. 2: First wave of pandemic influenza in Thailand, 2009



Epidemiological investigations indicated that the H1N1 virus favoured the crowd. Outbreaks happened in schools and entertainment places. An entertainment place early attacked was in Pataya, and then many cases spread out from that pub. Computer game shops created quite a number of cases in many provinces, especially among the youngsters. The computer keyboard served as the object of transmission. There were outbreaks in military camps and also in monasteries all over the country. The epidemiological characteristics of the disease were revealed from the work of the surveillance rapid response teams (SRRTs) who did a lot of investigations. The estimation of the reproduction number was based on school and military camp outbreaks. The reproduction number ranged from 1.4 to 1.7, averaging around 1.5. The attack rates were estimated in some population groups; for example, in schools, in military camps and in some institutions, the attack rates ranged between 33% and 60%. Among the infected people, the proportion of symptomatic cases was as high as 70%.

Response strategies were designed according to changing situations. From early detection and delaying the transmission in the introduction phase, the response strategy was quickly shifted to containment when the local transmission started. Then, we quickly moved to mitigation strategy when cases spread extensively. Activities in this phase included a campaign on the use of face masks, hand washing and improvement of medical service in the outpatient and inpatient clinics throughout the country.

Thailand has been continuously building upon its existing capacity, infrastructure, manpower and health care system and surveillance, like building the pyramid from the bottom up. The surveillance system has been improving over the past four decades starting with the routine surveillance system. Influenza and pneumonia surveillance was included in the routine reporting which had covered the whole country. When severe acute respiratory syndrome (SARS) appeared, a little adjustment was made in surveillance. A syndrome approach was included to cope with SARS detection. During that time there was no laboratory test for SARS; hence, a very classical surveillance and public health approach was used to capture suspected SARS cases. Then, based upon SARS surveillance, some additions were made to handle avian influenza outbreaks during 2004-2008. Some laboratory tests were added to strengthen the

surveillance and rapid response teams were activated across the country. One interesting development was the close collaboration and exchange between public health and animal health authorities to improve the surveillance in a synergistic way. Based upon avian influenza surveillance, additional actions were prepared for the upcoming pandemic influenza that included influenza-like illness (ILI) surveillance, severe pneumonia surveillance, modified laboratory testing and strengthened SRRTs. Now the existing pandemic influenza surveillance is put to test.

Another set of capacity building was observed in medical care. Since SARS, Thailand has been making significant improvements in its medical care capacities; for example, isolation rooms have been built in all public hospitals. During the SARS outbreak only big hospitals had isolation rooms. Now all public hospitals have at least one or more isolation rooms. Clinical practice guidelines have been developed and updated. Systematic training of medical staff annually is in place. Hospitals and their staff undertake simulation exercises. There was a worry that if many cases stormed in, the hospitals might not be able to cope. Therefore, technical assistance has been sought from the military to develop models for field hospital management.

Thailand enjoys the benefit of preparedness planning that has been made over the past four to five years in response to avian influenza outbreak. Under the coordination of a national committee, the national strategic plan has served as the framework for countrywide preparedness. The national plan has been conveyed to the provinces and under its framework local agencies are encouraged to formulate their own operation plans. Table-top exercises and functional exercises have been conducted over the past years (Fig. 3). The pandemic influenza preparedness has been readily integrated under the umbrella of the national public emergency preparedness and response system which, in case of emergency, is under the command of the Prime Minister. Based on existing capacities built under the pandemic influenza preparedness, a lot of surge capacity has been seen. Hospital managements have been able to cope rapidly with the rise in the number of cases. The stockpiles of antivirals and personal protective equipment have served well and timely. The private, semi-private and government sectors have been involved in business continuity planning and response.

Fig. 3: Exercises of pandemic influenza preparedness plans

Mass media has a significant role to play in pandemic response. However, at certain times, we are not doing very well with press communication. But looking back at the grass-root and community levels, communications has been carried out very nicely with the active participation of health volunteers, community leaders and NGOs. Excellent command and control and coordination under the framework of the government exist. Thailand has opted for building national capacity to secure access to H1N1 vaccine. This task is ongoing and is not finished yet. Research and development for vaccine production needs to be established. Thailand has purchased a certain amount of H1N1 vaccine which is being given to high-risk groups. However, in the early phase of vaccination there were public concerns over the safety of the vaccine that resulted in a slow vaccine uptake. We have learned that effective surveillance and communication are needed to respond to adverse events following immunization.

Several lessons have been learned from the experiences during the pandemic response – both of failures and successes. In an attempt to facilitate such learning, WHO's technical assistance was requested for a joint review of the pandemic response with the objective to identify strengths and weaknesses and to provide guidance on how to improve response during future threats.

A joint review was thus conducted in several areas by teams of WHO and local experts, led by well-known authorities. The review came up with useful findings and recommendations which included, among others, development of a regional knowledge network on clinical management, restructuring and streamlining of the communication committees, and development and implementation of a comprehensive national laboratory programme. It was also highlighted that Thailand should prepare a five-year strategic plan for influenza surveillance.

Box: Roles of epidemiology in public health emergency (PHE)

- **Before PHE**
  - Predict the nature, extent, severity & impact
  - Guide national preparedness planning
  - Monitor changes of the situation
- **During PHE**
  - Detect early occurrence, guide containment & mitigation
  - Monitor changes (causative agents, disease, people's reactions, etc.)
- **After PHE**
  - Evaluate impact (health, social & economic) & effectiveness of interventions
  - Guide further planning of preparedness for future PHE

In summary, the role of epidemiology in the preparedness for and response to H5N1 and H1N1 or other public health emergencies cannot be overemphasized. Before an emergency, epidemiology serves to predict the nature, extent and severity of the threat and its likely impact, guides national preparedness planning and monitors change of situation and actions. During the emergency itself, epidemiology leads to early detection of problems, guides containment and mitigation measures and helps monitor changes. Finally, after the emergency, epidemiology provides the basis for evaluation of its impact and formulation of lessons learned in order to prepare for response to emergencies in the future.

Thailand has benefited tremendously from the developments in epidemiology and its application in public health.

What pandemic activities should countries focus on now?

Keiji Fukuda

Readiness is always an essential stance in public health because important health events, such as an influenza pandemic but also other events, such as cholera, can arise at any time and can rapidly escalate in size, severity and complexity. There are a couple of main components of readiness. One is preparedness, a process in which future potential events and their anticipated demands are actively considered and this information and risk assessment is used to develop plans, capacities and partnerships needed to respond as optimally as possible. A second component is the development and readiness of the capacities themselves needed to respond. Although the essential capacities and structures, such as adequately trained staff, are critical, anticipating the potential challenges is needed so that the preparedness can be engaged in a strategic, efficient and sustainable manner. The anticipation of future challenges is the most basic part of preparedness and is an activity everyone in public health should participate in.

Once the 2009 influenza pandemic emerged and had spread worldwide, there were two main possibilities. One possibility was that the pandemic would evolve and transform into seasonal influenza patterns without any major surprises. A second scenario was that there would be some surprises along the way. For example, there might be changes in the virulence of the pandemic, as has been seen in the past. Or it was possible that important virus properties could change. For example, the seasonal influenza H1N1 virus (which was different from the pandemic H1N1 virus) rapidly and unexpectedly developed resistance to oseltamivir a few years ago. It is possible that any influenza virus, including the pandemic virus, may develop increased drug resistance without a warning. During the pandemic, it was also important to not forget the H5N1 virus. While most recent attention was focused on the pandemic, changes in H5N1 infection or transmission patterns would have required significant attention during the pandemic. These are examples of some of the scenarios that can and ought to be considered.

In the modern world, it has become clear that information about diseases can come through formal surveillance systems, but more often, comes through less-organized ways or systems. Information is now provided or obtained and spread in ways that no one would have imagined only a few years ago through, for example, the Internet. One must consider these less- established informal sources of surveillance as potentially important. The underlying lesson we must learn is how to use the information at hand. On the one hand, ensuring that we have systems to provide good quality and timely information remains a central public health activity. But in many ways the weakest link in the surveillance chain is how to rapidly assess available information and make it understandable and available to all those who need to know.

How to separate meaningful observations from the background noise, and how to move the surveillance information and get it to different parties fast enough, is not easy. Information has to go to decision makers, to general population and to the many groups in between and while remaining coherent. How to do that is one of the hardest parts of surveillance in the modern era.

Parallel Session 8

FETP and other applied epidemiology training programmes

Chairpersons: *Raina Macintyre*
V.Kumaraswami

Session Coordinator: *Shalini Pooransingh*

FETP in India: ten years of experience

– *A K Dhariwal & S.K. Jain*

Ten years of field epidemiology training at the National Institute of Epidemiology (ICMR), Chennai, India, 2001 – 2010 – *Murhekar MV, Manickam P, Bhatnagar T, Kaur P, Ramachandran V, Ramakrishnan R, and Kumaraswami V.*

Expansion and utilization of FETP and its graduates: experience in Thailand

– *Kumunan Ungchusak, Sopon Lamsirithaworn and Pasakorn Akarasewi*

Managing Information for Action (MIFA) training for peripheral TB control programme managers – *Nani Nair, Aime De Muynck, Suvanand Sahu, Sai Babu, Pravat Chandra Barua, Caterina Casalini, S Chadha, LS Chauhan, Erwin Cooreman, Puneet Dewan, KN Gupta, Hans Kluge, Thandar Lwin, Win Maung, Mojibur Rahman and Fraser Wares*

Field epidemiology training programme in India: ten years of experience

A.K. Dhariwal and S. K. Jain

The South-East Asia Region of WHO (WHO/SEAR) is facing a high burden of disease morbidity and mortality. There are continuous threats of disease outbreaks and emerging health challenges. The epidemiological capacities at the national, state and local levels are unequal and varied to implement the strategies for the containment or reduction of disease morbidity and mortality. In this backdrop, the National Centre for Disease Control (NCDC), India, has been organizing training programmes with the aim to build a sustainable epidemiological capacity at various levels to identify and respond to public health emergencies. Under the International Health Regulations (2005), it is mandatory to conduct field epidemiological investigations and support the health departments in these endeavours.

NCDC has been designated as the WHO collaborating centre since 1996. In this capacity, NCDC has been organizing field epidemiology training programmes for health personnel of countries in the WHO South-East Asia Region. The objective of this training is to strengthen technical capabilities and skills of health professionals in the application of epidemiological principles in the prevention and control of diseases.

The training programmes being organized at NCDC have a long history. A three-month field epidemiology training programme was started way back in 1963-64. After that, there was a Prague-Delhi course which was conducted for three months in Prague and three months in New Delhi. During 1983-87, a three-week epidemiology training course was started and then a three-month national field epidemiology training programme was initiated. With support from the United States Agency for International Development (USAID), a nine-month field epidemiology course also existed where the trainees used to work at their workplaces in the field and submit a dissertation.

Since 1996, a three-month Regional Field Epidemiology Training Programme (FETP) is being organized at NCDC for senior and middle-level health professionals from regional countries. FETP is one of the most important training programmes conducted by NCDC. Its objective is to build capacity in regional countries through strengthening the knowledge and skills in field epidemiology and its tools and applications. This programme is being conducted for inservice medical and health personnel responsible for public health activities. Fourteen such programmes have been successfully completed so far, where a total of 205 participants from various countries in the Region have benefited. (Fig.1).

To strengthen the competency-based FETP, the curriculum of the training programme was reviewed in 2006 to incorporate five weeks of classroom teaching, followed by six weeks of field posting for learning by doing and two weeks of evaluation upon return to the institute. Appropriate training material was developed. During the field posting, the participants are placed in a group of 5-6 persons at one of the NCDC's field units located in different parts of India. Faculty groups from NCDC and WHO periodically visit them to provide support and supervision. For field exercises, the participants review the literature and stay at respective places in the field to conduct outbreak investigations and undertake descriptive, analytical or evaluation studies. The participants do the field study themselves.

Fig. 1: Three-month Regional Field Epidemiology Training Programme:1996-2009

The five weeks of classroom teaching includes concept of field epidemiology, epidemiological tools, biostatistical applications, principles of outbreak investigations, disease surveillance and management of disease control programmes. The methodology of conducting FETP includes lectures, technical discussions, modular exercises, visits to institutions and field exercises. Basic skills for the use of EPI INFO at computer workstations are also provided. Field exercises are conducted in collaboration with the regional field units of NCDC. In this course, experienced faculty not only from NCDC but also from other national institutes and experts from WHO and other international agencies participate as trainers.

Besides the 3-month FETP, NCDC organizes a special course for paramedics for four weeks, which is in great demand, particularly from other countries in the Region. Detailed feedback is obtained from the participants and there is a system of continuous dialogue with the trainees.

A 2-year MPH course affiliated with Guru Gobind Singh Indraprastha University, Delhi, was started in 2006 with the objective to strengthen technical capabilities and skills of health personnel and to create a cadre of field epidemiologists. The course is open to both inservice and fresh candidates (Table 1). This course consists of four semesters having 26 credits. The focus in the first, second and fourth semesters is on interactive training using modules and exercises. Laboratory practical is also a part of the course in which microbiology, biochemistry and medical entomology is taught. Laboratory training is the strength of the institute which is needed in the present circumstances of emergence of many vector-borne and zoonotic diseases. Field exercises is another feature of the MPH course when the trainees participate in outbreak investigations, short projects, seminars and panel discussions and visit different organizations to observe public health activities. One semester is dedicated to the field-based project. It is a requirement of the university to submit the dissertation at the end of the semester. Topics of public health importance are covered in the fieldwork. Based on the experiences of the last four courses, experts advised that there was a need to re-examine the course curriculum. In the revised curriculum, there is now more emphasis on competency-based skill acquisition and 60% of the work is in the field, with close monitoring of the scholars.

Table 1: Master's in Public Health (Field Epidemiology) scholars, by background

S. No.	Batch	Fresh candidates		Inservice candidates		Total
		Medical	Non-medical	Medical	Non-medical	
1	2005-06	13	3	2	1	19
2	2006-07	11	2	4	0	17
3	2007-08	4	2	2	0	8
4	2008-09	2	2	4	2	10
5	2009-10	17	0	3	0	20
Total		**47**	**9**	**15**	**3**	**74**

The evaluation of the trainees of FETP has found a high degree of technical competence in them and they are holding senior positions in national health programmes, at medical colleges and in international health organizations. They are involved in the management of surveillance programmes, outbreak investigations and disaster management. Those who have undergone the trainers' course are now holding positions in various institutions, national health programmes and international health agencies (Table 2).

Table 2: Master's in Public Health (Field Epidemiology) scholars, by placements, trained

S. No.	Institution	Position	%
1	Central/ State government	Epidemiologist/ Programme Manager/ Medical Officer	60
2	International health agencies	Consultant	24
3	Teaching in institutions	Teaching faculty	14
4	Private hospitals	Medical Superintendent	2

NCDC has also been organizing extramural training programmes in neighbouring countries such as Bhutan, Maldives and Myanmar. A 15-day training programme was conducted for paramedics of these countries. This programme is in great demand because of its short duration and excellent content. Besides, NCDC has been periodically organizing sensitization of MPH mentors and orientation-cum-training of NCDC branches where the trainees are taken for field exercises, monitoring and post-outbreak training seminars. An experience-sharing epidemiology meet was organized at NCDC in May 2009.

In spite of all these efforts, there is a pressing need for a cadre of field epidemiologists at the Centre and in the states of India. Work is under way on the development of a career path and on the sustainability of a mix of short- and long- term courses on epidemiology, networking and intercountry and regional sharing of knowledge and experience.

Ten years of field epidemiology training at the National Institute of Epidemiology, Chennai, India, 2001-2010

M.V. Murhekar, P. Manickam, T. Bhatnagar, P. Kaur, V. Ramachandran, R. Ramakrishnan, V. Kumaraswami

In 2001, the National Institute of Epidemiology (NIE) of the Indian Council of Medical Research (ICMR) initiated a field epidemiology training programme (FETP) to facilitate the development of a cadre of public health professionals who are practitioners of epidemiology at the field level and are competent in addressing public health needs and priorities efficiently and effectively. The programme received technical support from the Centers for Disease Control and Prevention (CDC), Atlanta, USA, the World Health Organization (WHO) and the Australian National University. WHO also funded the initial two cohorts of the programme. Since 2003, the programme is fully funded by ICMR. The two-year course leads to the award of the Master's degree in Applied Epidemiology (MAE) from Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram, Kerala, an institute of national standing. MAE-FETP aims primarily at strengthening health services through the training of in-service middle-level health managers. Here, we provide an overview of the MAE-FETP.

Programme philosophy and course organization

MAE-FETP is modelled on the Epidemic Intelligence Services (EIS) programme of the CDC *(1)* and the MAE programme of the Australian National University *(2)*. MAE-FETP provides a two-year learning-by-doing experience to medical officers working at the district or subdistrict levels and who are interested in developing their careers in epidemiology and public health. As part of ICMR's commitment to strengthening the Indian public health system, this programme is offered free of cost to government-sponsored candidates.

This course consists of two parts: the first part is of six months (25% of course duration) of on-campus training during which the trainees (referred to as 'scholars') receive theoretical inputs through residential contact sessions at NIE. These contact sessions include an initial foundation course on applied epidemiology, biostatistics and public health surveillance. In the subsequent sessions, the scholars receive inputs on programme management, scientific writing, health economics and qualitative studies.

The other part extends for 18 months (75% of course duration) of field-based experience spread over three "field postings" of six-month duration each. During these postings, the scholars plan and execute epidemiological projects of immediate relevance to public health practice at field placement sites. The scholars and NIE, in consultation with the sponsoring state health authorities, identify the field placement sites (usually at district level). During the field work, the scholars receive technical support from the line-managers and NIE-based mentors. During this process, the scholars provide valuable information to the district programme.

Curriculum and competencies

MAE-FETP is a member of the Training Programs in Epidemiology and Public Health Intervention Network (TEPHIENT) *(3)*, a consortium of applied epidemiology training programmes across the world and uses an international curriculum template for the programme. However, the MAE-FETP has additional modules to suit the needs of the Indian public health system. The MAE-FETP curriculum combines in-class training and practical, hands-on experience through mentored fieldwork. The fieldwork provides practical learning opportunities for the scholars to implement concepts learnt during the contact sessions and acquire the competencies expected of them. The curriculum uses more than 25 case-studies based on Indian investigations in the areas of outbreak investigations, laboratory support for outbreaks, surveillance data analysis, evaluation of surveillance system, programme evaluation, framing the research questions, and ethics *(4)*.

The seven core competencies of the programme are: (1) mastering epidemiological science; (2) investigating outbreaks; (3) managing public health surveillance; (4) conducting epidemiological studies; (5) protecting human subjects in research; (6) oral and written communication; and (7) programme management and evaluation. Towards achieving these competencies, the scholars conduct the following field-based projects during the 18 months of field posting:

Public health situation analysis: As part of this assignment conducted at the beginning of the first field posting, the scholars review the field placement site and its population to place it into a public health perspective. It presents key selected health indicators (e.g. indicators towards the achievement of the Millennium Development Goals or others), identifies the key public health priorities of the district and identifies topics for various field projects as well as for the dissertation.

Outbreak investigations: The MAE-FETP model offers quality investigations of disease outbreaks, with full technical support from the faculty. Standard operating procedures consist of the classical 10-step approach that goes through four main stages of (1) confirmation; (2) hypothesis generation; (3) hypothesis testing; and (4) prevention measures. Peer review at all stages of the investigations and reporting is the keystone of the quality assurance process. Over the last 10 years, the scholars have investigated more than 100 outbreaks caused by bacteria (e.g. cholera, anthrax, leptospirosis, pertussis), viruses [e.g. measles, hepatitis A, hepatitis E, chikungunya, influenza A (H1N1)], parasites (e.g. malaria) and toxic agents (e.g. organophosphorous).

Surveillance projects: The MAE-FETP scholars produce two reports: first, an analysis of secondary data from surveillance, and, second, an evaluation of a surveillance system. These two mandatory projects build the key attitudes that a public health person needs in terms of surveillance: knowing everything one can say with data and knowing everything one cannot say with data.

Programme evaluation: The MAE-FETP scholars evaluate public health programme with a focus on logical framework and development of input, process, output and outcome indicators to identify existing gaps.

Operational research projects: As part of writing of the dissertation, the scholars have to conduct an epidemiological study on a locally-relevant health problem. The process that leads to the right research question is the key to the epidemiological investigation. The scholars do not do a project because they like a topic but they choose a subject because it will generate a body of data that will fill a gap in the information needs, and filling that gap must trigger some kind of action. The line managers play an important role in guiding the scholars to identify a locally-relevant health problem for epidemiological investigation.

Quality assurance

Several steps are followed to assure the quality of the training programme that include (a) ongoing evaluation of the teaching using qualitative and quantitative methods by the scholars; (b) use of peer review to develop improved learning tools; (c) documentation of the training conducted in a compact disc; (d) monitoring of the acquisition of the core competencies through the standardized supportive supervision tool; (e) evaluation of the final reports with standardized checklists; and (f) participation in the TEPHINET continuous quality improvement initiative.

Key achievements

The NIE-trained 68 MAE-FETP graduates and 33 current scholars have been assigned in 17 Indian states (Fig. 1). Several of these graduates are holding key positions in disease surveillance and other public health programmes (Fig. 2). All the MAE-FETP investigations are debriefed at the district and/or state level to ensure that those who need the information the most can take immediate action. The scholars' works have been presented in scientific meetings (55 oral and 120 poster presentations) and published in peer-reviewed literature (32 papers). The Indian FETP alumni network (IFANet), established to provide a platform for MAE-FETP graduates to remain connected and to share knowledge and experience with each other and other public health professionals in the country *(5)*, is playing an important role in the implementation of the epidemiology training activities of NIE through mentoring of current scholars.

Fig. 1: Placement of MAE-FETP scholars and graduates by Indian states, 2001-2010

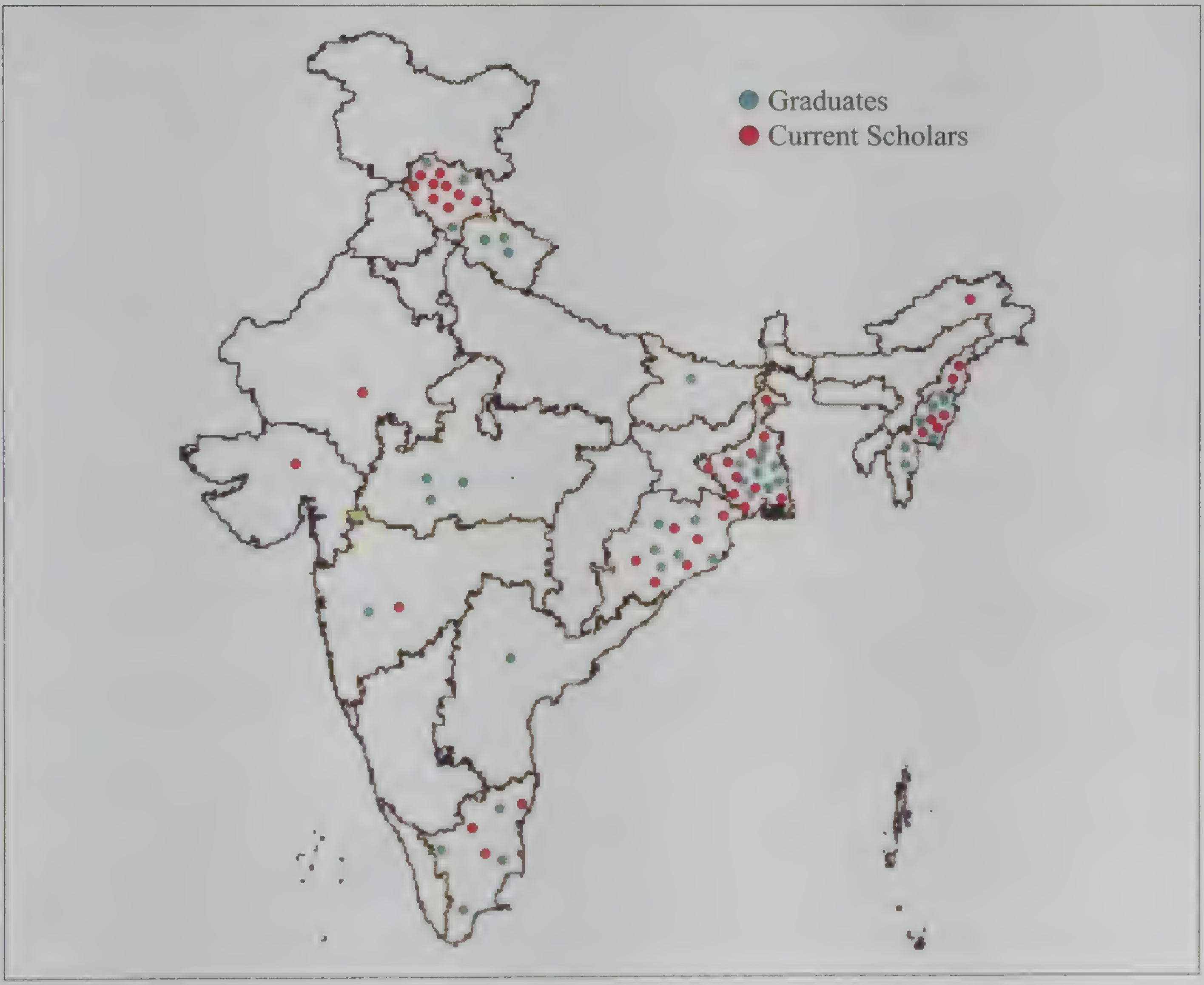
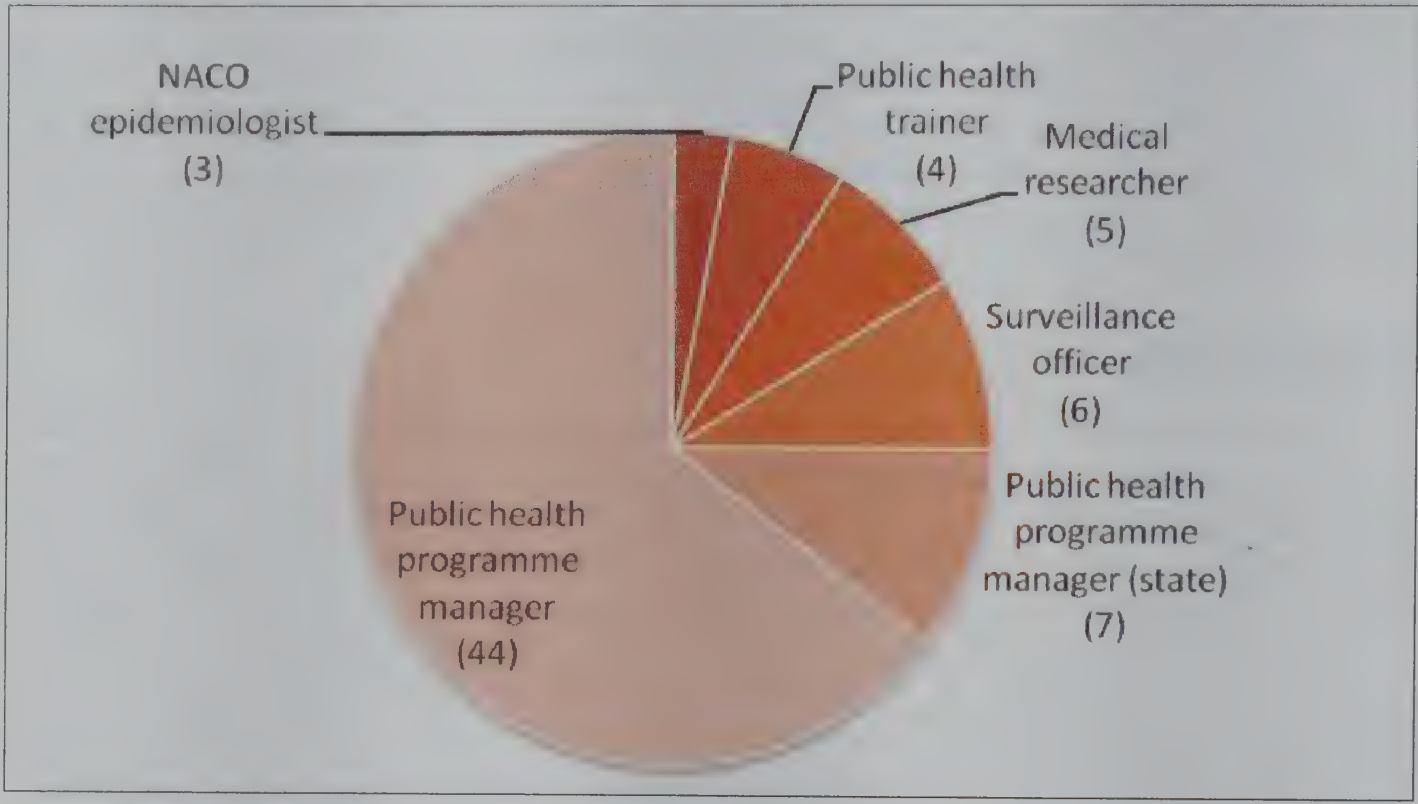


Fig. 2: Assignment of MAE-FETP graduates, 2001-2010, NIE, India



Future challenges and opportunities

While MAE-FETP has contributed significantly towards strengthening the public health workforce in the country, several challenges still exist. These include strengthening field-level supervision and mentoring, establishing linkages at the national level for outbreak investigations, reaching the unreached states, and defining career pathways for the graduates.

Acknowledgement

The authors acknowledge Prof. M. D. Gupte, former Director, NIE, and founder of the MAE-FETP in India, and Prof. K. Mohandas, former Director of SCTIMST, Thiruvananthapuram, for their vision and contribution to the programme.

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Expansion and utilization of FETP and its graduates: experience in Thailand

Kumnuan Ungchusak, Sopon Iamsirithaworn and Pasakorn Akarasewi

The Field Epidemiology Training Program-Thailand (FETP-Thailand) was established in 1980 with the collaborative effort of the Thai Ministry of Public Health (MoPH), the World Health Organization (WHO) and the US Centers for Disease Control and Prevention (CDC). It is the first field-based epidemiology training centre outside the American continent which was modelled after the Epidemic Intelligence Service in the USA *(1,2)*. The term 'FETP' has been recognized as applied epidemiology training that directly links to public health services. Between 1980 and 2010, over 40 similar training programmes have been established globally *(2)*.

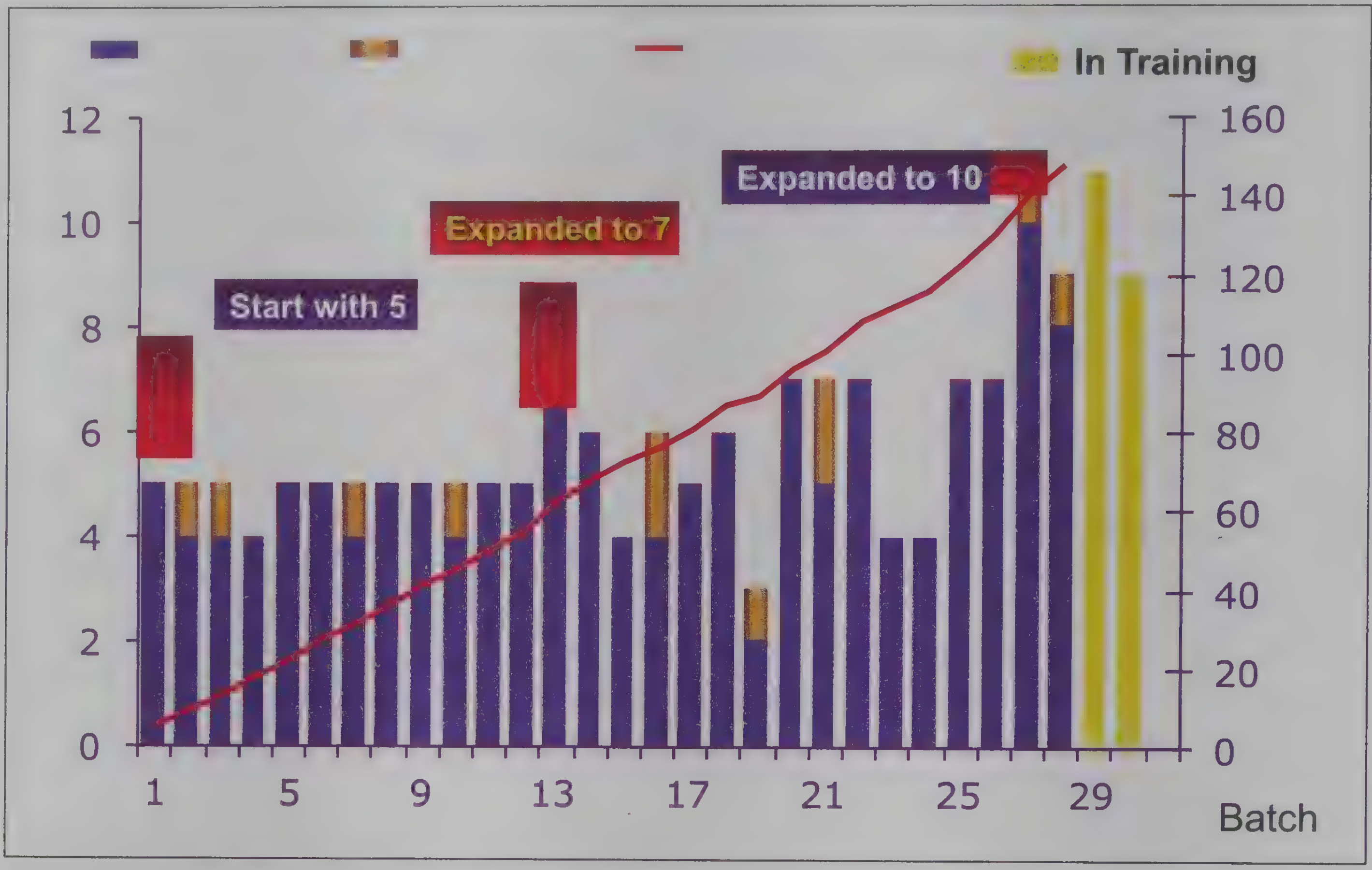
The philosophy of FETP-Thailand is "Learning by Providing Services". Thai FETP has recruited young physicians, who have a high interest in public health service, in the 2-year inservice training at the MoPH central level. By a priority setting, the time spent on field activities accounts for 70% while the other 30% is allocated to non-field activities. Trainees learn about the national surveillance system by analysing data and interpreting and disseminating findings for policy decision of MoPH. They also get opportunities to conduct a surveillance evaluation or involve themselves with establishment of a new surveillance system. Each trainee investigates 3-5 outbreaks as a principal investigator and reports key findings to local authorities and policy-makers. An epidemiological study is carried out to understand and propose appropriate responses to solve major health problems of the country. In the area of public health emergencies, FETP trainees are on the frontline in the field of response. Close supervision by a well-trained adviser is a vital component of the field training.

Up to 2009, the programme has produced 148 medical epidemiologists to serve in various public health programmes in Thailand. Around 102 (70%) of these graduates have served in MoPH by providing epidemiological services at the national and local levels. Another 17 (11 %) work in universities, the army, the navy and the Bangkok Metropolitan Administration. The programme also has 13 (9%) alumni who work with international organizations such as WHO, UNFPA and Thailand-US CDC Collaboration (Fig. 1).

Although the programme has been important for public health service in Thailand, it could not compete with other postgraduate training courses in medicine. In 1984, after a lot of effort and convincing, the Thai Medical Council agreed that the graduates of the programme were eligible for certified board of preventive medicine after completing the 2-year field training plus another year of study for the Master's of Public Health degree. This has granted to the FETP graduates the status equivalent to other medical specialists.

The HIV/AIDS pandemic provided the first opportunity for the FETP programme to demonstrate its usefulness and effectiveness. Trainees and graduates from FETP assisted in investigating the first 100 AIDS cases in the country and also the epidemic among drug users and sex workers. The FETP graduates helped in establishing sentinel surveillance systems to monitor the HIV prevalence and risk

Fig. 1: Number of Thai graduates from Thai FETP cumulative graduates (n=148), dropped out (n=11), 1980-2009

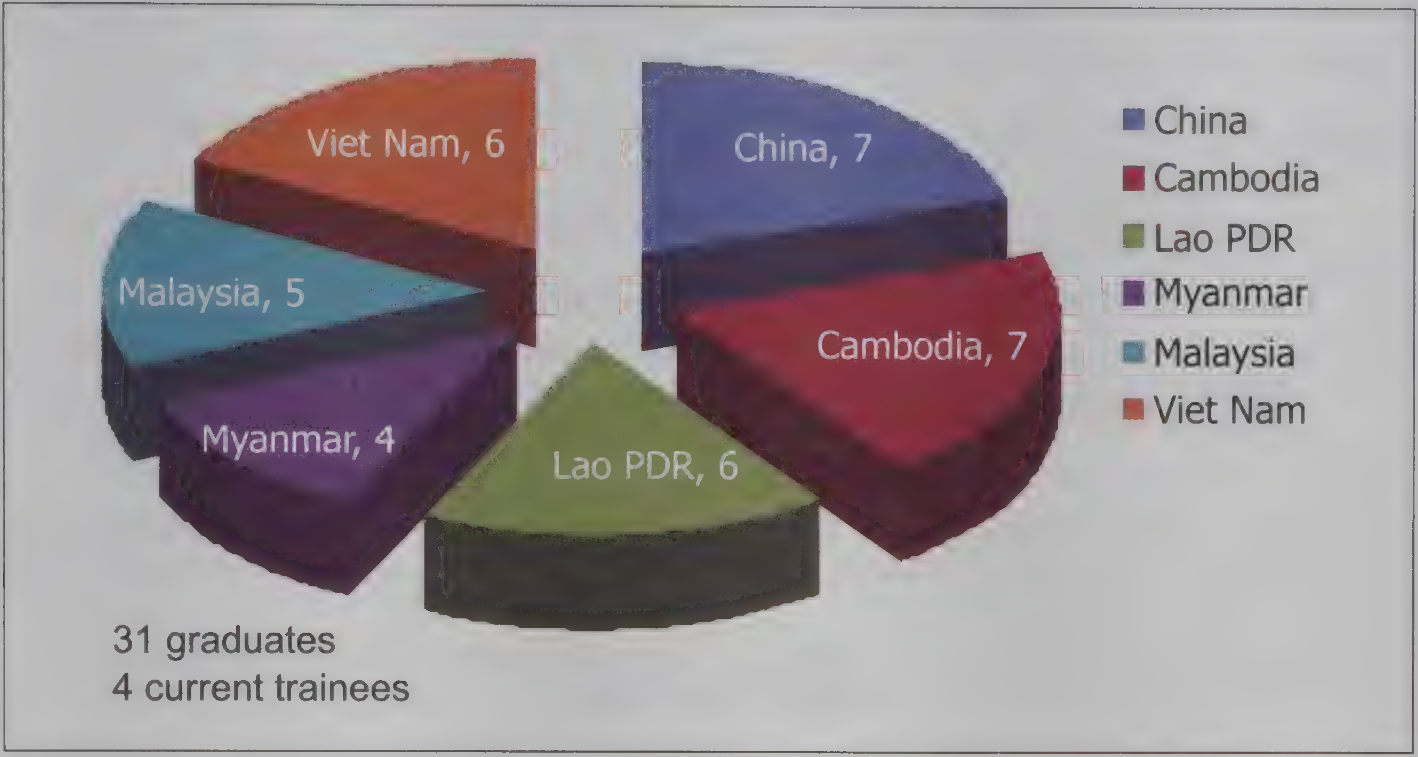


behaviours among the target populations *(3)*. In addition, they played a vital role to develop, advocate and implement key interventions including "100% Condom Program" *(4)*. The other example is the programme to reduce mother-to-child transmission of HIV. In response to an increased need for field epidemiologists, the training capacity of the programme was endorsed by the Thai Medical Council to increase from 5 to 7 trainees per year starting from the 13th class.

In 1998, during the Asian financial crisis, the FETP-Thailand received less budgetary support and was therefore of less attraction for the new generation of medical professionals. By converting the crisis into opportunity, the MoPH offered its training services in response to the call of the WHO South-East Asia and Western Pacific regional offices and regional surveillance network initiatives such as the Mekong Basin Disease Surveillance. Thai FETP had the opportunity to welcome public health professionals from Cambodia, Lao PDR, Viet Nam, Yunnan province of China and Myanmar. The goal is to build epidemiology capacity in the south-east Asian region, especially in countries in the Mekong subregion. On an average, 2-3 international trainees are admitted to the programme and trained for two years. By early 2010, the cumulative number of international graduates who have trained at FETP was 31 and four are currently in training (Fig. 2). After an 8-week introduction of basic epidemiology in the classroom and field studies, the trainees perform actual surveillance study and outbreak investigations in their home country under the supervision of a local adviser. Every six months, they return to the training centre in Thailand to work with the programme adviser and share their works and experiences with colleagues from other countries.

The severe acute respiratory syndrome (SARS) and avian influenza crises around the world in the new millennium brought a new opportunity to the FETP-Thailand. Its graduates were assigned to provide technical support and develop national strategies to control the crises. A timely surveillance and effective response mechanism made the containment of the health consequences possible. The MoPH has gained the trust of the Thai public and international community. With this recognition, there were three major proposals on manpower capacity building to prepare for future threats of new emerging diseases.

Fig. 2: Number of graduates from other countries and current trainees, 1998-2009 (N = 35)



First, the Thai Cabinet has endorsed a 10-year master plan to increase the capacity of the FETP in order to produce 200 well-trained epidemiologists by 2014. The programme was approved by the Thai Medical Council to increase the number of trainees from 7 to 10 per year. Moreover, field epidemiology has been listed as a 'priority career' in public health and entitles those trained to obtain a monthly government subsidy at the same level as other highly recognized specialists, e.g. neurosurgeons. Additional trainers were recruited and placed in the training centre to assure quality training of more trainees.

Second, the Field Epidemiology Training Program for Veterinarians (FETP-V) was started in 2005 to meet the need for a more effective response to zoonotic diseases. Annually, 2-3 veterinarians from the Department of Livestock Development (DLD), Ministry of Agriculture and Cooperatives, are recruited into the collaborative 2-year training programme. Of the six FETP veterinarian graduates so far, five have been assigned to work in the central office of DLD and one works in the provincial office. Joint investigations of zoonotic diseases by medical epidemiologists and veterinary epidemiologists in the field have resulted in a better control of epidemics.

Third is the establishment and training of 1030 Surveillance and Rapid Response Teams (SRRT) to function in all districts of Thailand *(5)*. Each team has approximately three health staff who receive short-course training in surveillance and investigation and is supervised by more experienced epidemiological officers at the provincial level. FETP graduates are key persons in the training of SRRTs and provide technical support when needed. The majority of deputy provincial chief medical officers are also the provincial SRRT leaders. They have been trained in the specially-designed 6-month course. They were required to conduct and share the lessons learned of epidemic investigation and disease control activities in their province. Many of them also conducted an evaluation of the surveillance system.

After three decades of existence, the FETP-Thailand has been recognized as the backbone of epidemiological services and broader public health responses in Thailand *(6)*. However, it has not always been smooth sailing and the programme has faced many challenges along the way. We should turn every crisis to a new opportunity. With the aim to provide timely response and high-quality

epidemiological services, FETP-Thailand has a great chance to continue its growth by getting support from policy-makers and the public. Meanwhile, it will also attract a newer and brighter generation of young people to progress in this important career.

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Managing Information for Action (MIFA) training for peripheral TB control programme managers

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The WHO South-East Asia Region (SEAR) carries the highest burden of tuberculosis (TB) cases among all WHO regions; one in every three TB patients in the world resides here. Five of the 22 countries with the highest burden of TB in the world are part of this Region. Although most countries have achieved significant progress in TB control, there is still a need to build capacity for better surveillance, monitoring and evaluation *(1)*. This need becomes even more evident given the fact that the evaluation of progress towards the Millennium Development Goals (MDGs) is relying more on routine surveillance data than on successive surveys *(2)*.

Monitoring missions to review TB programmes in the regional countries have shown important deficiencies at all levels, particularly at district level, in recording, compiling, analysing, interpreting and assessing routine surveillance data *(3,4,5)*. Shortcomings in supervising data management, recognizing problem areas and giving appropriate feedback to field staff were also observed.

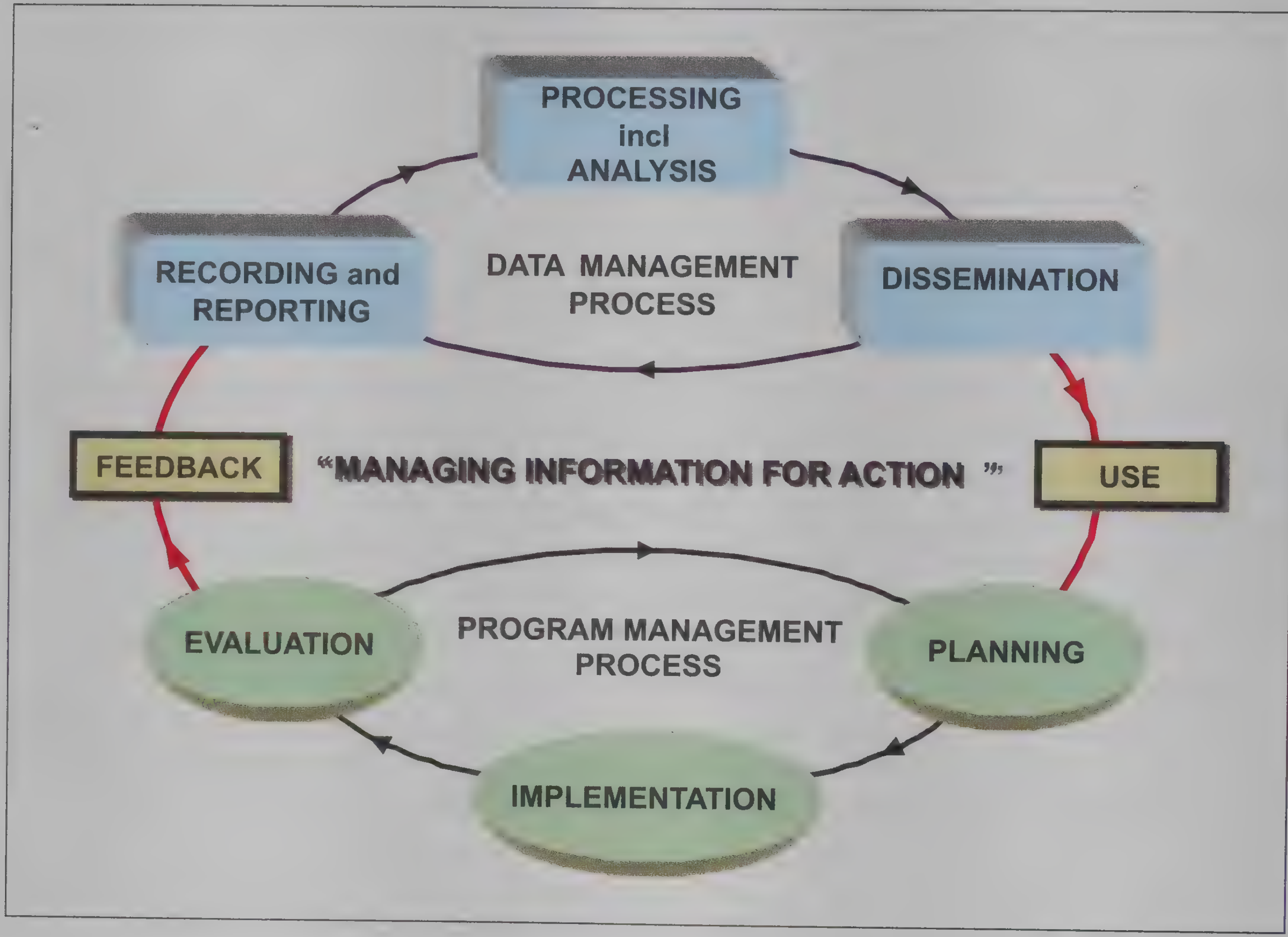
Translation of routine data by peripheral-level TB programme managers into rational decisions and actions for programme improvement remains a neglected area. It must be recognized that focusing on data management is indeed a challenge for TB managers operating at peripheral and intermediate levels, given the many competing demands on their time. Deficient data management affects programme management, often reducing district-level managers to mere implementers of instructions from higher levels *(6)*.

These deficiencies are not unusual as many of the programme managers in developed and developing countries are clinicians who lack the necessary skills for programme management *(7,8)*. This is partly because clinicians are not well trained in field epidemiology or statistics and lack an interest in these subjects *(9)* as they perceive these as being irrelevant to their work *(10)*. In an attempt to fill these gaps, various vertical disease control programmes have organized short courses in computer-supported data analysis, focusing on summarizing data and making disease estimations. However, training to make TB managers aware of the strengths and weaknesses of data to draw relevant conclusions for programme management, rather than burdening them with sophisticated statistical methods, has been absent *(11)*. To remedy this deficiency, a training course titled Managing Information for Action (MIFA) was developed by the Regional Office.

The specific objectives of MIFA training are:

- To strengthen the interface between data management and TB control programme management;
- To increase the knowledge, skills and motivation of TB managers in order to make them capable of transforming routinely collected data into information useful for making appropriate decisions to improve programme management;
- To facilitate application in routine work through involvement of supervisors.

Fig: Managing information for action



A unique aspect of the MIFA course is that it is built on the everyday experiences of the participants in dealing with data, involving supervisors as course facilitators, and linking management and analysis of routine data to critical decisions in programme management (Fig.). This is done through a three-way group interactive learning experience between course instructors, participants and facilitators. The participants in the course are doctors working at peripheral level (district, division or province) as TB control officers.

Components of the course

The training has four components: (i) pre-course assignment; (ii) theoretical course; (iii) post-course implementation; and (iv) follow-up and assessment.

1. The pre-course assignment focuses on selected case-finding and case-holding *indicators*, intended *to bring* participants more in touch with their own data and to start appreciating data as a source of useful information.

2. The theoretical-practical course lasts one week and is structured around three building blocks:
   a. TB control programme data management implementation practices, through a review of the pre-course assignment, analysis of the various sections of the quarterly cohort programme reports, and using local examples to reflect the actual country situation.
   b. The course itself focuses on:
      - the data Management Information System (MIS) in use, epidemiological indicators, data summation, graphic displays, mapping and time-place-person epidemiological descriptions;
      - causal modelling of the potential causes of a given problem;
      - developing a concrete action plan to address identified problems.
   c. Assessment of acquired knowledge and insights gained through daily reviews.

A set of training modules were developed with each module ending with an exercise coached by a facilitator. To increase comprehension, key messages were summarized in respective local languages where necessary. The main focus was on the retention of key skills and on inducing a change of attitude towards evidence-based programme management. Supervision of the post-course implementation was seen as a critical element for ensuring the full impact of the training. Field supervisors monitored and coached the post-course implementation and gave supplementary ad hoc training as required. Assessments of the impact, through monitoring of post-course application of concepts learned and use of data in work situations, were carried out during review meetings organized six months after the course.

Course assessment

Each course was assessed through pre- and post-testing of knowledge and skills, as well as an assessment of the attitudes towards evidence-based programme management. The assessment was based on Kirkpatrick's model which focuses on reaction (participants' satisfaction with the training), learning (increase of knowledge and skills and change of attitude), behaviour (post-course job performance) and impact (contribution of the training to the programme objectives in terms of quality improvement, and increase of efficacy, efficiency and equity) *(12)*.

Discussion

Evidence-based public health practice can be said to follow five elements: setting priorities, developing management guidelines, measuring programme performance, improving programme performance, and resetting priorities based on an analysis of how performance might be improved *(13)*. Setting priorities, developing management guidelines and resetting priorities based on performance information are usually addressed by the central units of the respective national TB control programmes. The measurement and improvement of performance at the peripheral level generally remains weak, especially where the peripheral staff lacks the skills and attitude for evidence-based programme management. To strengthen the peripheral level, it is necessary to increase capacity to collect, analyse, interpret and use programme performance data. Immediate post-course assessment as well as assessments carried out at six months in the field showed that the MIFA training had brought about a substantial change in the attitudes and practices of TB control programme officers working at the peripheral level. Many TB control managers had started practising evidence-based programme management and thus improved their programme performance.

Conclusion

The MIFA course imparted basic descriptive epidemiological and statistical knowledge and skills, produced a shift in attitudes towards evidence-based programme management and increased the participants' interest in data management and data-supported decision-making. This resulted in a more effective programme management style, intensified the involvement of supervisors in data management and improved programme performance. Effective post-course implementation was found to be influenced by the involvement of supervisors and the interest of the supervisors and the central level of the TB control programme in bottom-up programme management. Given the turnover of supervisors, building a critical mass of trained supervisors at national and subnational levels may also be required. A more rigorous and longer-term assessment of the post-course implementation and its influence on programme performance needs to be carried out.

Acknowledgments

The authors thank all the respective National TB Control Programmes and WHO country offices in the Region for their support in the preparation, organization and follow-up of these courses, and especially Dr Meena Som (India) and Dr Ye Myint (Myanmar).

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Parallel Session 9

Establishing the Evidence – Informed Policy Network (EVIPNet)

Chairperson: *Ulysses Panisset*

Session Coordinator: *Ong-arj Viputsiri*

EVIPNet: the concept and the modus operandi – *Ulysses Panisset*

Evidence to policy and action through partnership – *Paul Garner*

EVIPNet in the WHO Western Pacific Region: lessons learnt – *Rebecca Dodd*

EVIPNet in the WHO South-East Asia Region: possible options – *Prathap Tharyan*

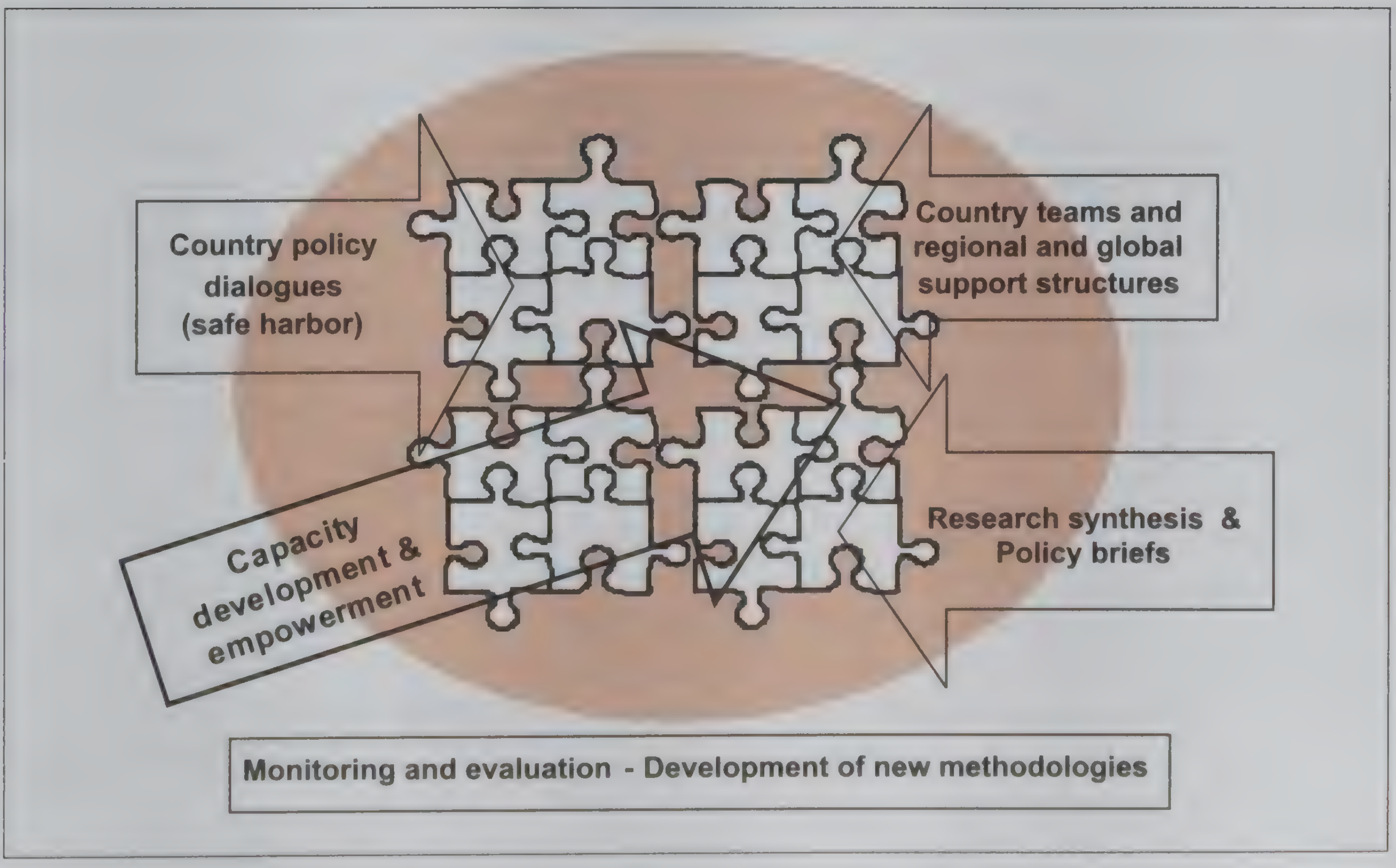
Evidence-informed policy network (EVIPNet): the concept and the modus operandi

Ulysses Panisset

EVIPNet is a social and collaborative network that promotes the systematic use of health research evidence in policy-making. Focusing on low- and middle-income countries (LMICs), EVIPNet promotes partnerships between policy-makers, researchers and civil society in order to facilitate both policy development and policy implementation through the use of the most reliable scientific evidence available. EVIPNet comprises networks that bring together country-level teams, which receive technical support from regional- and global-level steering groups.

EVIPNet was set up in response to a 2005 World Health Assembly resolution calling for WHO to establish or strengthen "mechanisms to transfer knowledge in support of evidence-based public health and health care delivery systems and evidence-based related policies". EVIPNet promotes knowledge translation into policies as a decision- making mechanism in which the dynamic elaboration of research agendas and the formulation and implementation of policies benefit from the feedback of additional research *(1)*. The experience of EVIPNet's members has shown that this mechanism requires a series of building blocks needed to promote evidence-informed policy-making in a sustainable manner (Fig.1).

Fig.1: EVIPNet building blocks



Country teams are the foundation of EVIPNet. The ministry of health appoints the members of the team in each respective country. The team comprises both policy- makers and researchers. In some large countries, such as Brazil and China, state or provincial teams were established with certain autonomy, but were linked to or coordinated by the central ministry of health. EVIPNet has a series of regional (Asia, Africa and Latin America) and global governing structures that help support the work of country teams and promote interaction and exchange of experience at global level *(2)*.

Research syntheses and policy briefs are key deliverables developed by country teams. Policy briefs are instruments that have several different forms and languages according to the audience. They target policy-makers, media and nongovernmental organizations (NGOs). Research on the use of evidence to inform policy-making has demonstrated clearly that research synthesis and policy briefs are extremely useful and influential in getting acceptance by policy-makers for implementation of policy. Each country team produces its own evidence-informed policy brief, because health interventions are affected by different contextual, political, cultural and sociological factors that shape the decision-making process in each national situation *(3)*.

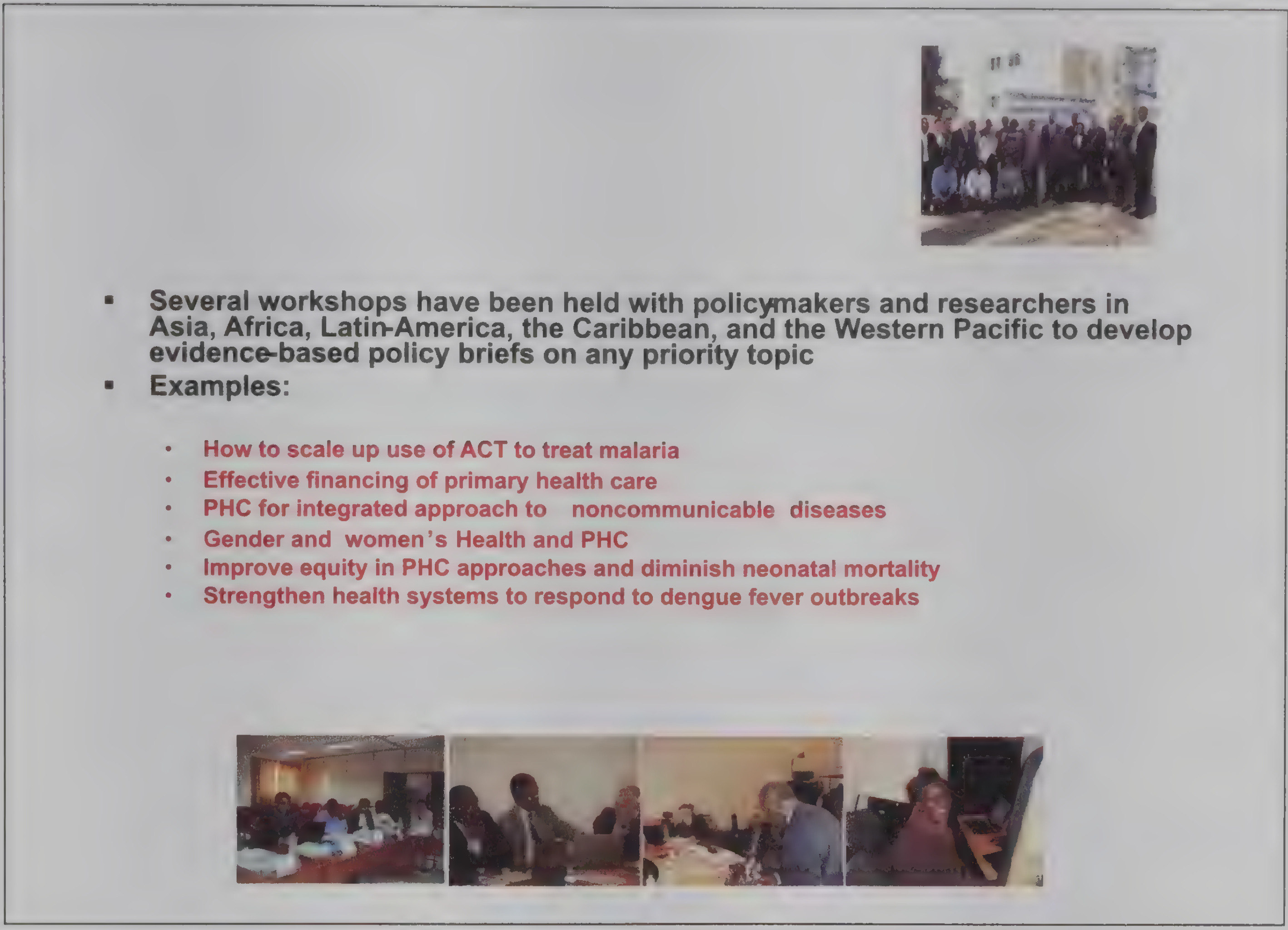
A systematic review of studies evaluating policy-makers' perceptions of their use of evidence identified that the elaboration of summaries with policy options will increase the chances that policies will be informed by the best available scientific evidence *(5)*. Thus, EVIPNet policy briefs are research syntheses in a user-friendly format, offering policy options informed by scientific evidence. EVIPNet policy briefs differ from regular policy briefs in that they involve systematic and transparent efforts to contextualize the results of systematic reviews to country-specific situations and to integrate that evidence with national research results to support well-informed policy decisions *(6)*.

To better develop policy briefs and the implementation of policies through the use of the best available research evidence, EVIPNet has worked with leading experts in the last three years to develop the SUPPORT tools for evidence-informed policy-making and pilot-test them in several workshops with selected country teams in Africa, Latin America and Asia. EVIPNet country teams adopted these tools designed to use WHO guidelines, several systematic reviews addressing health systems issues and national health information. The tools allow countries to make policy that responds to their own needs and resources.

The EVIPNet tools are now being applied to different problems in Africa, Asia and Latin America and the Caribbean. These include: maternal and child mortality; the integration of noncommunicable diseases programmes at community level; effective financing of primary health care; and access to macro and micro nutrients and outbreak response. All policy briefs address policy options to improve the demand for, access to and/or delivery of health systems.

EVIPNet focuses on ***capacity development*** with the concept of empowerment of country teams to work independently. Thus, most of EVIPNet efforts are directed at developing and strengthening national capacity so that countries will hopefully continue to work on high standards of knowledge translation into policy. In EVIPNet workshops, policy-makers and researchers jointly produce evidence-informed policy briefs to improve the chances of working together later on in a sustainable manner (Fig. 2).

Fig. 2: EVIPNet policy brief workshops



In a typical work flow to writing a policy brief, a country team uses evidence to identify and clarify a priority problem. As next steps, evidence is used to frame options to address the problem and to address how an option will be implemented. EVIPNet considers well-graded systematic reviews as the gold standard to make sure that the policy is informed by the best available evidence. After deciding on how much confidence to place in a systematic review (grading) and assessing the applicability of the findings of a systematic review, country teams find and examine evidence about local/national conditions. A key consideration is research evidence about resource use (human, infrastructural, financial) and costs. Throughout the whole process the team takes equity into consideration when assessing policy options *(7)*.

The ***national policy dialogue*** is another key building block of EVIPNet´s work flow. This deliberative dialogue is an instance in which researchers and policy-makers get together with representatives of civil society and discuss the final draft of a policy brief. The dialogue helps to capture best practices and experiences and represents a reality check to the evidence-informed policy options offered by the country team in a policy brief. EVIPNet country teams are currently renewing efforts to better engage civil society representatives in the evidence-informed policy-making process with innovative projects in Africa, particularly in Cameroon and Burkina Faso. The McMaster Health Forum, the World Health Organization, the Ontario Agency for Health Protection and Promotion, the Public Health Agency of Canada and the Global Health Research Initiative convened a stakeholders dialogue to help set the stage on the subject of civil society engagement in supporting research use in health systems *(8)* (Tables 1 and 2).

Table 1: Policy brief's options from Burkina Faso on how to scale up malaria treatment (4)

Table 1. Policy Options

Policy option	Motivate the community health workers (CHWs) responsible for home management of uncomplicated malaria	Ensure private-sector stakeholders comply with national guidelines on subsidized pricing of artemisinin-based combination therapies (ACTs)	Recall antimalarial drugs used in single-drug therapy for uncomplicated malaria
Description	• Train CHWs • Supervise and provide guidance to CHWs • Cover CHW training costs and expenses	• End pricing structure applicable to malaria treatment • Introduce subsidies for treatment of uncomplicated malaria • Contracting arrangements for provision of subsidized ACTs by private health facilities	• Draft and promulgate regulations to discontinue single drug therapies (Ministerial order retracting the marketing authorization for single-drug therapies, inter ministerial order to halt imports, etc.) • Organize recall of current stocks • Destroy stocks in approved manner • Reimburse owners for recalled and destroyed stocks • Inform/raise awareness among the general public
Advantages	• Involving community health workers in maternal and child health programs (compared to usual care) can reduce mortality in children under 5 years and morbidity from common childhood illnesses (10) • Training workshops, alone or combined with other activities, can improve professional practice and treatment outcomes for patients (7) • Fewer severe malaria cases in the community • By bringing treatment closer to the home, mothers will change their health-seeking behavior (1;8;9) • Reduction in health workers' workload, enabling them to devote their freed-up time to other health tasks	Evidence indicates that: • The private sector is an important health provider for the poor in low- and middle-income countries • Many measures involving the private sector can be successfully implemented in poor communities (12) • Increases in health-care costs tend to reduce the demand for treatment	• Effective treatment of uncomplicated malaria (if treatment with single-drug therapy is replaced with ACTs) • Fewer severe malaria cases • Fewer malaria-related deaths
Disadvantages	Overuse leading to possibility of rapid emergence of resistance to ACTs (6)	There is growing evidence that the private sector fails to provide high-quality care (2)	Resurgence of single drug therapy through black market in contraband medication, corruption
Cost	CFAF 10 billion[a] (based on the malaria incidence rate, the number of uncomplicated malaria cases treated with ACTs dispensed by private facilities, the cost of ACTs and the level of subsidy according to age group)	CFAF 5 billion[b] (based on the malaria incidence rate, the number of uncomplicated malaria cases treated with ACTs dispensed by private facilities, the cost of ACTs and the level of subsidy according to age group)	CFAF 50 million[c] (based on estimated stocks of chloroquine and other artemisinin-based single-drug therapies as per import and consumption data)
Acceptability	• Decision makers at the Ministry of Health (favorable) • Technical and financial partners (mixed) • Procurement office (CAMEG) (favorable) • Pharmacy managers (unfavorable) • Associations and NGOs (very favorable) • Patients (mixed)	• Decision makers at the Ministry of Health (favorable) • Technical and financial partners (favorable) • Procurement office (CAMEG) (favorable) • Private pharmacists (mixed) • Patients (very favorable)	• Decision makers at the Ministry of Health (favorable) • Procurement office (CAMEG) (favorable) • Pharmacy managers (mixed) • Street vendors of medicines (unfavorable) • Patients (neutral)

[a]US$22.8 million.
[b]US&11.4 million
[c]US$0.1 million.

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Table 2: Policy brief's summary of potential obstacles and strategies for implementation, from Burkina Faso

Malaria treatment policy brief for Burkina Faso

Table 2. Implementation of the Policy Options

Policy option	Ensure private-sector stakeholders comply with national guidelines on subsidized pricing of artemisinin-based combination therapies (ACTs)	Motivate the community health workers (CHWs) responsible for home management of uncomplicated malaria	Recall antimalarial drugs used in single-drug therapy for uncomplicated malaria
Obstacles to implementation	• No procedure for contracting with private facilities in the strategic plan for malaria control (5) • Essential Generic Medicines Procurement Office (CAMEG) stock inaccessible to private pharmacists • Lower profit margin on ACTs for private sector • Insufficient community input	• No national strategy for community-based intervention • Opposition from parents/patients if not informed of CHW role • Opposition from CHWs due to increased workload if motivation is insufficient	• Opposition from pharmacists and other vendors due to loss of profit margin • Lack of public enthusiasm, preference for tried and trusted medications
Strategies for implementation	• Lobby pharmacists, clinics and private practices to enter into a formal contract • Lobby CAMEG • Mobilize additional resources to finance ACT subsidies • Information campaign in the media targeting communities	• Fine-tune the national strategy for community-based services (6) • Introduce financial incentive scheme for community intermediaries based on profits from sale of ACTs • Tailor training of community intermediaries to their role and tasks • Referral centers for health and social welfare (CSPS) to guide and supervise community intermediaries	• Issue an interministerial order prohibiting the import and use of single-drug therapies • Public relations campaign to modify attitudes to single-drug therapy • Organize recall of single-drug therapies and document their destruction (3) • Reimburse recalled and destroyed stock • Launch information campaign in the media targeting communities

A ***monitoring and evaluation process*** throughout the whole knowledge translation work of country teams helps the whole network to learn from each member's experience and improve existing knowledge translation methodologies. An ongoing, five-year research protocol looks at what really works in what context and to find commonalities and differences between each country team's processes. This protocol attempts to capture the diversity of country teams in order to enrich the collective experience of EVIPNet.

Thus, EVIPNet acknowledges that one size does not fit all and encourages innovations in knowledge translation into policy by each participating country. In some neighbouring countries there may be similar ethnicities, languages and experiences, but the realities can be entirely different, requiring flexibility in identifying what works in different contexts. In a country of continental proportions like India, where even in one state there can also be so much cultural diversity and a multitude of different views, country teams must experiment with different organizational scopes and forms.

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Evidence to policy and action through partnership

Paul Garner

Ensuring that decisions in the health sector are embedded in reliable evidence is important to make the best use of scarce resources. It helps to make health services effective and efficient, in both what public health policies and clinical care packages contain and how they are delivered.

In the health sector, we all recognize the gap between what is known to be good practice and what is actually done. In recent years, there has been a revolution in synthesizing research, and we now know that we need reliable synthesis to contribute to evidence-informed decision-making. Systematic reviews are necessary but not sufficient to ensure that evidence translates into policy and practice.

The Effective Health Care Consortium uses systematic reviews to prepare policy- relevant accessible products for a variety of policy networks. Influencing these policy networks is a central part of the Consortium's communication strategy, and during this presentation we take some case-studies of research to practice and lessons that we have learned about how to do this successfully. Fig. 1 shows an approach to engaging people in policy networks in evidence. It emphasizes the two-way relationship between people synthesizing research, the messages they produce, and the policy networks that use the knowledge in decision-making.

Fig. 1: Increasing evidence-informed decisions in the health sector

India blindness control

Question: What is better than a researcher with a good research policy question? Answer: A policy-maker with a good research question! The case-study presented concerns a member of the Indian Administrative Service, responsible for the India Blindness Control Programme, who carried out a cost-effectiveness evaluation of options for cataract surgery. A systematic review of intracapsular extraction and aphakic glasses showed a good outcome of surgery and dramatic increases in quality of life *(1)*. This policy-maker asking research questions demonstrated poor outcomes for camp surgery *(2)*, and it was unclear how this information could be expressed to government without offence. So there was a great deal of dialogue between policy-makers and researchers, and some further work was done to explore this. In addition, a systematic review showed the problem of poor outcomes to be more widespread than people had thought. Camp surgery was then dropped. This case-study illustrates that research needs to be question-driven; there are great advantages with policy-makers being involved in research; systematic reviews help set the context; and policy dialogue is essential for change.

Global WHO malaria guidelines*(3)*

The Cochrane Infectious Diseases Group has been working for over 15 years with the World Health Organization on malaria policy *(4)*. More recently, it has been formally involved with the Malaria Guidelines Group (Figs. 2, 3). Although there has been some resistance to using systematic reviews as a basis for decision-making because of the impression that consensus based on opinions was more valuable. Over the years, with the development of Grading of Recommendations Assessment, Development and Evaluation (GRADE) and a demand for explicit decision-making, the malaria panel is using evidence much more directly and explicitly, particularly in systematic reviews.

What helps researchers is good, clear questions to address; what helps policy-makers are good, clear answers. There are now so many trials published that systematic reviews are essential in malaria, and the process of dialogue in the panel helps steer the synthesis of relevant trials and helps the panel understand and adopt the outputs of the reviews.

Fig. 2: Synthesis specialists working with the WHO Malaria Guidelines Group

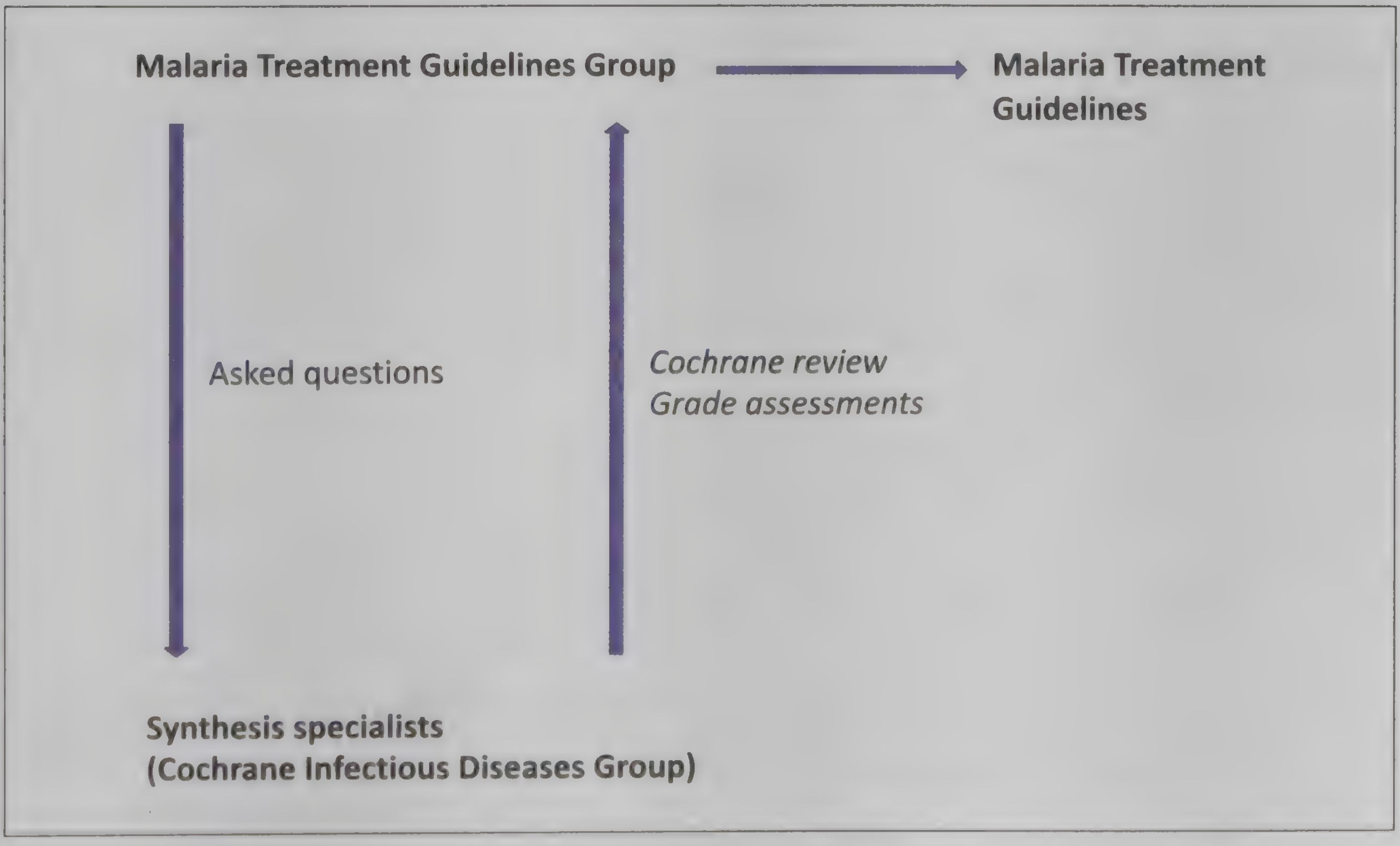

Fig. 3: Example of a GRADE profile

Question 1. Should DHA-P be recommended world wide?

1. A Question: Is dihydroartemisinin-piperaquine a reasonable alternative to artemether-lumefantrine for treating uncomplicated malaria in endemic areas worldwide?

Quality assessment							Summary of findings					
							No of patients		Effect		Quality (Robustness)	Importanc
No of studies	Design	Limitations	Inconsistency	Indirectness	Imprecision	Other considerations	Dihydroartemisinin-piperaquine	Artemether-lumefantrine	Relative (95% CI)	Absolute		
Effectiveness: Total Failure (P. *falciparum*) Day 42 PCR unadjusted												
4	randomised trial	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision	none	143/781 (18.3%)	235/711 (33.1%)	RR 0.52 (0.42 to 0.65)	137 fewer per 1,000	HIGH	IMPORTA
Effectiveness: Total Failure (P. *falciparum*) Day 42 PCR adjusted												
4	randomised trial	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision	none	24/662 (3.6%)	48/524 (9.1%)	RR 0.4 (0.25 to 0.65)	37 fewer per 1,000	HIGH	CRITICAL
Transmission potential: Gametocyte development (in those negative at baseline)												
3	randomised trial	no serious limitations	no serious inconsistency	no serious indirectness	no serious imprecision	none	25/555 (4.5%)	42/523 (8.0%)	RR 0.55 (0.34 to 0.89)	51 fewer per 1,000	HIGH	IMPORTA
Harms: Serious adverse events (including deaths)												
4	randomised trial	no serious limitations	no serious inconsistency	no serious indirectness	very serious	none	10/992 (1%)	6/972 (0.6%)	RR 1.61 (0.58 to 4.39)	4 more per 1,000	LOW	IMPORTA
Harms: Early vomiting												
2	randomised trial	serious	no serious inconsistency	no serious indirectness	very serious	none	18/575 (3.1%)	13/572 (2.3%)	RR 1.38 (0.68 to 2.74)	7 more per 1,000	VERY LOW	IMPORTA

[1] Data was also available for day 28 but this is not included in this table as it provided no further useful information.
[2] Allocation concealment was adequate in all trials
[3] Losses to follow-up in one trial in Asia (Ratcliffe 2007) were high (>15% at day 28 and >25% at day 42). Sensitivity analysis removing this trial did not substantially affect the result.
[4] Although there is considerable heterogeneity, all trials favoured DHA-P. The magnitude of this benefit was variable between settings.
[5] Three trials were conducted in Africa (2 in Uganda, 1 in Burkina Faso) and one trial in Asia (Indonesia), in areas of unstable, moderate and high transmission. Trials included children aged >6 months and adults.
[6] Pregnant women were excluded from all trials.
Please note that due to it's long half-life treatment failure with DHA-P may be underestimated at this time point.
[7] Both limits of the 95% CI of the pooled estimate suggest appreciable benefit with DHA-P over AL.
[8] Heterogeneity was low.
[10] Although there was substantial heterogeneity the 95% CI of all trials overlapped.
[11] Trials in Africa (Uganda and Burkina Faso) in areas of moderate and high transmission in children aged >6 months and adults.
[12] The 95% CI of the pooled estimate include appreciable benefit with DHA-P over AL and non-appreciable benefit.
[13] Three trials reported on changes in haemoglobin from baseline to day 42 and no appreciable clinical difference between drugs was shown. This information was not considered helpful in decisic making.

THE COCHRANE COLLABORATION

Nigeria and malaria

One state in Nigeria set up a policy group to help define their malaria policies. This group used operational research findings, opinions, results from global research synthesis and local epidemiology to decide on their policies. The group is using global and local information together in an informed way to make decisions.

Summary

Using evidence for policy and action is about partnership between researchers and policy-makers, with policy-makers understanding research findings and researchers understanding policy processes (Box). Often, researchers move into policy and this helps understanding. For success in India, this needs collaboration between researchers, particularly those working in synthesis, with policy-makers and technical experts who focus on a problem or a policy window, develop skills in understanding research, including its limits. They should appreciate the process that needs to develop over time and work with small teams working on specific projects.

Box: Learning points for research to policy

- **Good clear simple question helps (researchers)**
- **Good clear simple answers help (policy-makers)**
- **Need systematic reviews – so much evidence**
- **Process of engagement with policy-makers**

Acknowledgements

Consortium Partner leaders in Europe (Andy Oxman), Africa (Jimmy Volmink), South Asia (Prathap Tharyan) and China (Wang Yang). This presentation is personal and does not necessarily reflect the views of the members of the Consortium.

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EVIPNet in the WHO Western Pacific Region: lessons learnt

Rebecca Dodd

The aims of EVIPNet Asia, in line with the global EVIPNet, are to promote the systematic production and use of health research for policy-making, in the process forging partnerships between policy-makers and researchers and building capacity for health systems research. It is important to emphasize the partnership aspect, because that is what makes EVIPNet different from other initiatives in the field of health systems research and represents its key added value.

Health systems research is more complex and problematic than research in other areas of public health, in part because the success or failure of particular health systems policies is dependent on context, and in part because health systems is a multidisciplinary field which touches on social science, political economy and many other areas. This makes it difficult to gather robust evidence of 'what works', and means that traditional secondary research methods such as systematic reviews are not always relevant.

EVIPNet Asia was launched in 2005 following a World Health Assembly resolution which encouraged low- and middle-income countries to improve the production and use of knowledge for better health outcomes. Following that resolution, the ministries of health in the WHO Western Pacific Region (WPR) were requested by the WHO Western Pacific Regional Office (WPRO) to nominate teams that could form part of a network in Asia. Five countries responded, and seven teams were established that included three in China and one each in Viet Nam, Lao PDR, Malaysia and the Philippines (Table). The teams have a range of institutional homes: from ministries of health to research institutes to universities. This reflects the EVIPNet's aim of trying to link researchers and policy-makers.

Table: Structure of EVIPNet in WHO Western Pacific Region

- **China**
  - **Beijing**
    Beijing Center for Disease Prevention and Control
  - **Shandong**
    School of Public Health, Shandong University
  - **Sichuan**
    Health Policy and Information Technology Research Institute, Chengdu
- **Philippines**
  Health Policy Development and Planning Bureau, Department of Health
- **Viet Nam**
  Department of Science and Training, Ministry of Health
- **Lao People's Democratic Republic**
  National Institute of Public Health, Ministry of Health
- **Malaysia**
  Institute for Health Systems Research, Ministry of Health

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EVIPNet Asia has a loose governance arrangement. There is an informal management committee made up of EVIPNet team members, a Chair and a Secretariat provided by WPRO. The Secretariat manages a small budget for studies or research projects (which is awarded to country teams in response to proposals that they submit) and manages the peer review of policy briefs and papers once complete. Overall funding is limited which creates challenges for expanding the network and sustaining it in the longer term.

EVIPNet Asia organizes one regional workshop every 1-2 years, bringing together teams from different countries. In 2007, there was a workshop on the conduct of systematic reviews. In 2009, the workshop focused on creating policy briefs and on communicating research evidence and synthesis to policy-makers. Following this workshop, four teams began working on a policy brief that would aim to present evidence on a health systems policy issue of concern in their country. In Malaysia, the focus was on waiting times at primary health care facilities; in Viet Nam, on public-private partnerships; and in Sichuan, China, on experience with compulsory rural service for health workers. In each case, the teams used systematic review techniques to gather evidence from other countries on these issues and then drew recommendations for their own policy-makers. The format of the policy brief was designed to be accessible and useful for policy-makers, with key messages upfront, a longer executive summary, and then the detailed evidence in the main section of the brief. Each policy brief is peer-reviewed by an international expert, who also provides feedback and support to the country team.

Other activities at country level include subnational workshops, held in Malaysia and China, where EVIPNet team members pass on their new research skills to colleagues in other academic institutions. There have also been a number of policy dialogue events which aim to bring researchers and policy-makers together to discuss research findings and ideas for future studies. This is another important aspect of EVIPNet – influencing the research policy agenda and identifying research questions that are of interest to local policy-makers.

A review of the EVIPNet model suggests that it presents both challenges and opportunities. In terms of opportunities, EVIPNet provides a forum for linking national and international researchers, allowing mentoring and capacity building. In the same way, the network brings together teams from different countries and facilitates south-south learning. Finally, by linking researchers and policy-makers, EVIPNet contributes to the process of building a culture of evidence-based or evidence-informed policy-making in the health sector.

However, the governance and management of EVIPNet presents a major challenge. Ensuring that the right people, working in the right institutions, are engaged is essential. Teams need to have a strong and credible reputation for research, but should also have good access to government leaders and policy-makers – a difficult and rare balance. Furthermore, the nature of the research work – which is time-consuming and challenging – requires very motivated and capable team members. The process of establishing and maintaining the team thus becomes critical because it influences the quality of the research work that follows.

This links to the next challenge: the trade-off between capacity building and quality. As teams master new research techniques, their output at first may not be of high quality, which, in turn, will impact on its usefulness.

The final challenge is that EVIPNet is operating in a crowded marketplace. Other institutions – many of them better funded – are competing for the time and capacity of the same health researchers who are also members of EVIPNet. However, these institutions often come with a defined research programme. By contrast, EVIPNet funds are not associated with any specific technical agenda beyond the very broad area of health systems. It is the country team that identifies the policy question for investigation, not the donor. This, in turn, helps to ensure ownership and relevance and points again to the added value of the EVIPNet approach.

EVIPNet in the WHO South-East Asia Region: possible options

Prathap Tharyan

Evidence-informed policy-making involves two separate steps: (1) getting the right evidence; and (2) figuring out how best to get it used *(1)*. To illustrate this, let us consider a case which was brought to the High Court of Delhi recently. A writ petition was filed under Article 226 of the Constitution of India, highlighting how irrational vaccines were being arbitrarily introduced and promoted by the Government of India at the behest of vaccine manufacturers and other vested interests. The petitioners were a former health secretary of the Government of India and eight other eminent people.

The Ministry of Health and Family Welfare, the National Technical Advisory Group on Immunization and the Indian Council of Medical Research were on trial. The accusations were that newer vaccines were being pushed by the government into the National Immunization Programme and that the government had closed down virtually all public sector units that were supplying essential vaccines at a lower cost. The equity, sustainability, evidence and priority issues had been raised. This petition highlighted the government's policy of the proposed introduction of a pentavalent vaccine containing DPT, hepatitis B and haemophilus influenza type B (Hib) and contended that this vaccine was of doubtful utility and unproven efficacy, was also expensive, and hence was not required. The petitioners further argued that the six antigens included in the country's immunization schedule had inadequate coverage, and inclusion of an additional vaccine will drive costs and be unsustainable. Attention to detail and a transparent process is what really make a good health policy. There should be a structured, transparent and inclusive process so that petitions like this can be prevented.

Policy should be informed by the best available evidence to clarify the problem, to frame potential options and to anticipate potential implementation issues. It must be rooted in the realities of the people for whom it is meant. For example, there are differences in disease prevalence and health care delivery systems in different parts of India and other countries in the WHO South-East Asia Region. National policies often are at variance with the guidance given by professional associations. Many private practitioners follow guidelines of their professional associations. Due to issues of equity, gender, poverty, age, tribal and urban and rural areas, policies affect people differently. How is policy going to address these issues? There is also a huge problem of governance and regulation. All of these have to be factored into any national policy.

Policy-making is a dynamic process. Decisions have to be taken in very short time-lines. Questions asked in parliament are often to be answered within two weeks. Prioritizing policy options is very important, but one also needs to factor in the fact that once an epidemic hits, it can change all policy processes that were set to answer the question that might have been raised very realistically and systematically. Policy-makers have different views on the evidence that is required. They do not necessarily understand the language of science, and researchers also do not understand the demands of policy-making. So, there is a need for a dialogue.

Another issue is that each country would like to have evidence from within rather than from outside the country. Actually, the best evidence is often global evidence because that helps in understanding various options and processes that work or do not work in different health care delivery systems and settings. Eventually, evidence will have to be contextualized. Local evidence may not always be available. Hence, some aspects of global evidence can be evaluated for local applicability. One cannot reject everything that does not originate locally, although there is a need to get evidence, particularly from countries within the Region.

Research evidence – global, regional or local – may be lacking, incomplete, imperfect and even contradictory. However, policy-makers still have to make policy. To win the trust of stakeholders, health policy needs to be based on, and also be seen to be based on, a very transparent process that considers all available evidence, referencing what evidence has been used, evaluating the strengths and limitations and involving stakeholders in all stages of the process. They should also be involved in prioritizing what the policy issues are, monitoring how the options are implemented, evaluating the impact, and making adjustments when better evidence becomes available (Table).

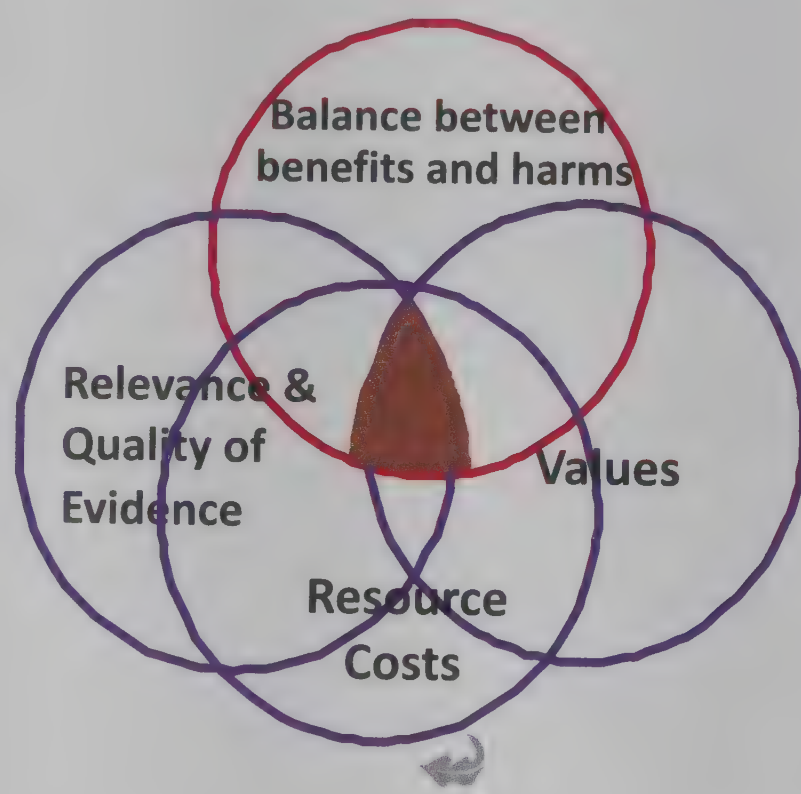
Table: Study designs best suited to answer different aspects of health policy

Steps in health policy-making	Design of studies best suited to answer the question
Clarifying the problem	Observational studies, qualitative studies, administrative databases
Framing potential options:	
Benefits	Randomized controlled trials Interrupted time series Controlled before-and-after studies
Harms	As above Observational studies
Economic issues	Cost-effectiveness studies
Implementation research	Qualitative studies (interviews, focus groups) carried out with quantitative studies (process evaluation)
Views of stakeholders	Qualitative studies, observational studies

Randomized controlled trials (RCTs) are not always the best option for all aspects of this process. To clarify a problem one needs to identify observational studies as well as qualitative studies and one may even have to look at administrative databases. No RCT can ever supplement this. However, for framing potential therapy options, RCT has a benefit as it provides straightforward, unbiased and a head-to-head comparison of simple interventions. For more complex interventions, such as public health interventions, one has to use good-quality interrupted-time series studies, controlled before-and-after studies, though other types of observational studies may also be important. For economic issues, one would need cost-effectiveness studies. For implementation of research, qualitative studies may be needed. Epidemiology is also very important when it comes to evidence in policy-making. Expert opinion is also important but it needs to be combined with reliable evidence and appraisal of the evidence. Ideally, professionals need to get more training in the new methods that will improve their ability to make expert decisions. Systematic reviews can help in this because they tend to identify all studies using a bias-free method, though they may or may not use meta-analysis to synthesize available

data. For example, a review that changed policy around the world concerned treating eclampsia with magnesium sulphate, which was being used for many years but not everywhere. A systematic review concluded that magnesium sulphate was a promising intervention though the evidence was insufficient to warrant a change in practice. This led to a large, multi-country trial that was used to update the systematic review and this changed the policy *(2)*. For more complex interventions like the number of antenatal care visits that are required, systematic reviews can help guide policy. What actually needs to be taken into account is not just the evidence but also the local contextual facts, the balance between benefits and harms, resource costs, values and the relevance and quality of the evidence (Fig. 2).

Figure 2: Factors that influence translation of evidence to policy recommendations



A structured approach should be taken to apply certain standards to first assess the quality of studies and evidence. It is a sequential process used by a panel that will then use judgements to make it more applicable locally. The evidence needs to be fed into this process, and for guidelines panels, the evidence quality depends on various issues, i.e. values, balance of harms and benefits and costs. Formulation of a recommendation is a more complicated process. It is not something that can be done just because one happens to know the subject. It requires a structured process of looking at the research studies, evaluating them, creating evidence summaries and grading them using the internationally accepted Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach *(3)* for quality issues. The guideline panels then get involved to consider the quality, the balance of harms and benefits, values and preference and resource costs and make recommendations, which would tell how much confidence they have in the evidence that underpins the recommendations. (http://www.health-policy-systems.com/supplements/7/S1)

Another question that is asked is whether a particular systematic review can be applied to a particular setting. There are structured processes to make this kind of decision. One has to see what kind of local evidence one would need to actually implement the guidelines.

There are also structured processes for dealing with equity issues. When something is done to one group, does another group get disadvantaged? Is there any reason to believe that this can happen? The process needs to be made very simple because policy-makers would need a very brief document. This is what the Support Summaries prepared by the SUPPORT Collaboration (http://www.support-collaboration.org/summaries/methods.htm) are about that are used as policy briefs. An example of the policy brief is whether birth attendants improve health behaviours for better pregnancy outcomes. (http://www.iecs.org.ar/support/iecs-visor-publicacion.php?cod_publicacion=21&origen_publicacion=publicaciones). A very brief summary with key messages tells what the evidence is and what the factors are that need to be considered while implementing it. A simple look at this type of policy brief will help a policy-maker arrive at decisions. The policy brief also gives evidence in the form of a summary statement of the interventions, participants, settings, outcomes, what kind of studies were used, and a summary of findings, which even give references. These briefs have relevance for low- and middle-income countries in terms of applicability, equity, cost-effectiveness and monitoring and evaluation.

Policy dialogues are needed with representative groups involving the public to find practical ways of implementing and monitoring and evaluation. This is what makes good health policy. But that does not necessarily happen because the process is not followed. Capacity building is really important and that is where EVIPNet (http://www.who.int/rpc/evipnet/en/) can strengthen existing systems. It can facilitate the process of going through the structured and systematic way of developing policy briefs.

The Cochrane Collaboration (www.cochrane.org) can also help because it is an independent organization devoted to producing, maintaining and disseminating systematic reviews of the effects of interventions in health care. The South Asian Cochrane Network & Centre (www.cochrane-sacn.org) is an independent centre of this collaboration representing the South Asian Association for Regional Cooperation (SAARC) countries.

India has six network sites, all of which are involved in doing systematic reviews. There are also sites in Pakistan, Sri Lanka and Bangladesh. People here are involved in asking questions of relevance to health care in this Region and their number is increasing (Fig. 3).

Fig. 3: South Asian Cochrane Network & Centre

The Indian Council of Medical Research (ICMR) has access to the best single source for the effects of interventions used in health care from the Cochrane Library. The government has actually paid a national subscription and people are increasingly using the Cochrane Library (www.thecochranelibrary.com). There is an effort to find all the trials that have been conducted in the region. A website (www.cochrane-sadcct.org) now gives a listing of all the controlled trials done in the Region, but evidence is also needed on all the observational studies gathered in one place otherwise that will not be utilized for contextualizing the evidence. There are lots of experts in the Region who can help with capacity building and can also help build systematic reviews.

The first EVIPNet meeting in India was held in January 2010, and two weeks after that the Government of India's Department of Health Research has sent a formal invitation through the WHO

Regional Office to EVIPNet to help build capacity in India. Now, the question is how to structure the network and what partnership models to take. Working together with EVIPNet can certainly make a big difference to evidence-informed policy-making in India and in the Region.

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Parallel Session 10

Leadership, management and epidemiology

Chairpersons: *S.D. Gupta*
A.S. Abdullah

Session Coordinator: *Sudhansh Malhotra*

Leadership and management: key for health action – *Jay Satia*

Leadership management and epidemiology: issues at country level – *Tee Ah Sian*

Management modules in epidemiology training to strengthen health system: experience of the Master's in Applied Epidemiology programme at the National Institute of Epidemiology, Chennai, India – *Yvan Hutin*

Leadership and management training course for tuberculosis control – *Saroj Jha*

Leadership, management and epidemiology: keys for health action

Jay Satia

Over the last several decades, much progress has been made in improving people's health. For instance, the maternal mortality ratios (MMR), infant mortality rates (IMR) and teenage pregnancies have declined while contraceptive prevalence rates have increased. However, the progress is uneven. Despite the talk of globalization, there is a great variation in health indicators. For instance, among the South-East Asian countries, while MMR is high in Bangladesh, it is quite low in Sri Lanka.

A large number of indicators show that health is still a matter of wealth, and this is a cause for concern. For instance, the higher the national per capita income, the lower the IMR and MMR (Figs.1 and 2).

Some countries at the same income level compared to others do very well but generally the higher the income, the better the health indicators. By and large, therefore, at each income level some countries can indeed do better and perhaps should do better. Even within countries, health indicators such as under-five mortality rate(U5MR) (Fig. 3), differ among different wealth quintiles. The poor are not able to access health care services as much as people in the top wealth quintile because of information, social, physical and financial barriers. Governments have taken several actions to address these barriers, including conditional cash transfers, systems strengthening, and public-private partnership (PPP). Nevertheless, innovation is needed to devise a cost-effective path to address these barriers.

Considerable health inequalities among and within countries pose a leadership challenge because the problem has persisted for a long time and there really is no consensus on how it should be addressed.

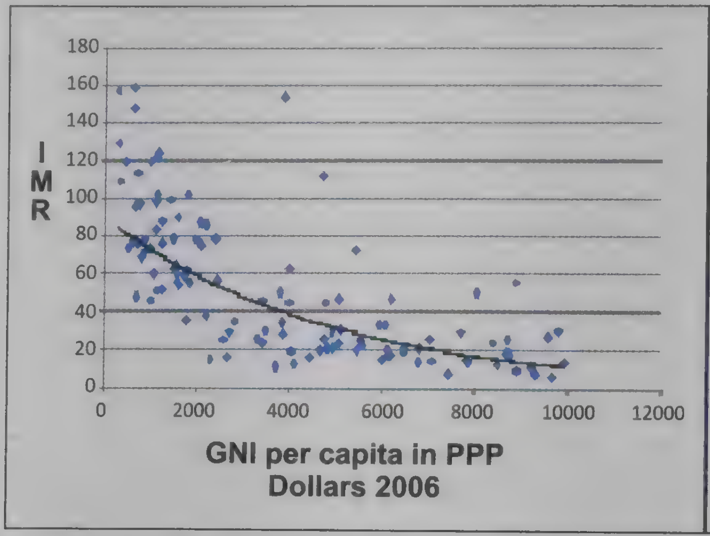
What is leadership?

There is a vast amount of literature available on leadership *(1)*. However, the leader has to go where others have not gone before – in a country or in a district or wherever he or she is. Leaders should take people to a future that they have not seen yet. This is challenge leadership faces: what kind of future people want and how to get there.

The strategic leadership framework combines leadership and management (Fig. 4):

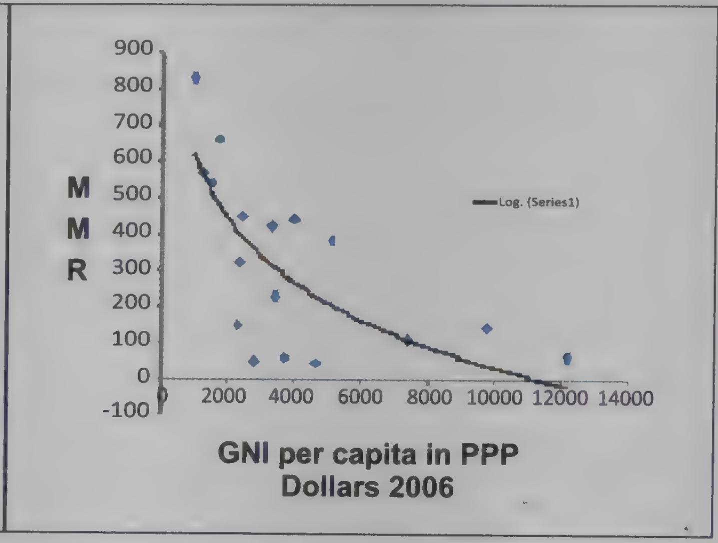
- Leadership means creating a shared vision of future among key stakeholders because the leader wants to take people to that future. One has to look at the vision reality gap and then find a path of how to bridge this gap. The word 'path' here connotes a broader concept than strategy as strategy implies how to traverse that path. The leader has to inspire stakeholders and empower them to move towards a shared vision. Leadership and management are, of course, complementary.
- In management, one develops a strategy, goals and targets derived from the path to be followed to realize the shared vision. The manager then has to plan, organize, monitor and evaluate actions.

Figure 1: Health is still a matter of wealth: Infant mortality rate (both sexes)



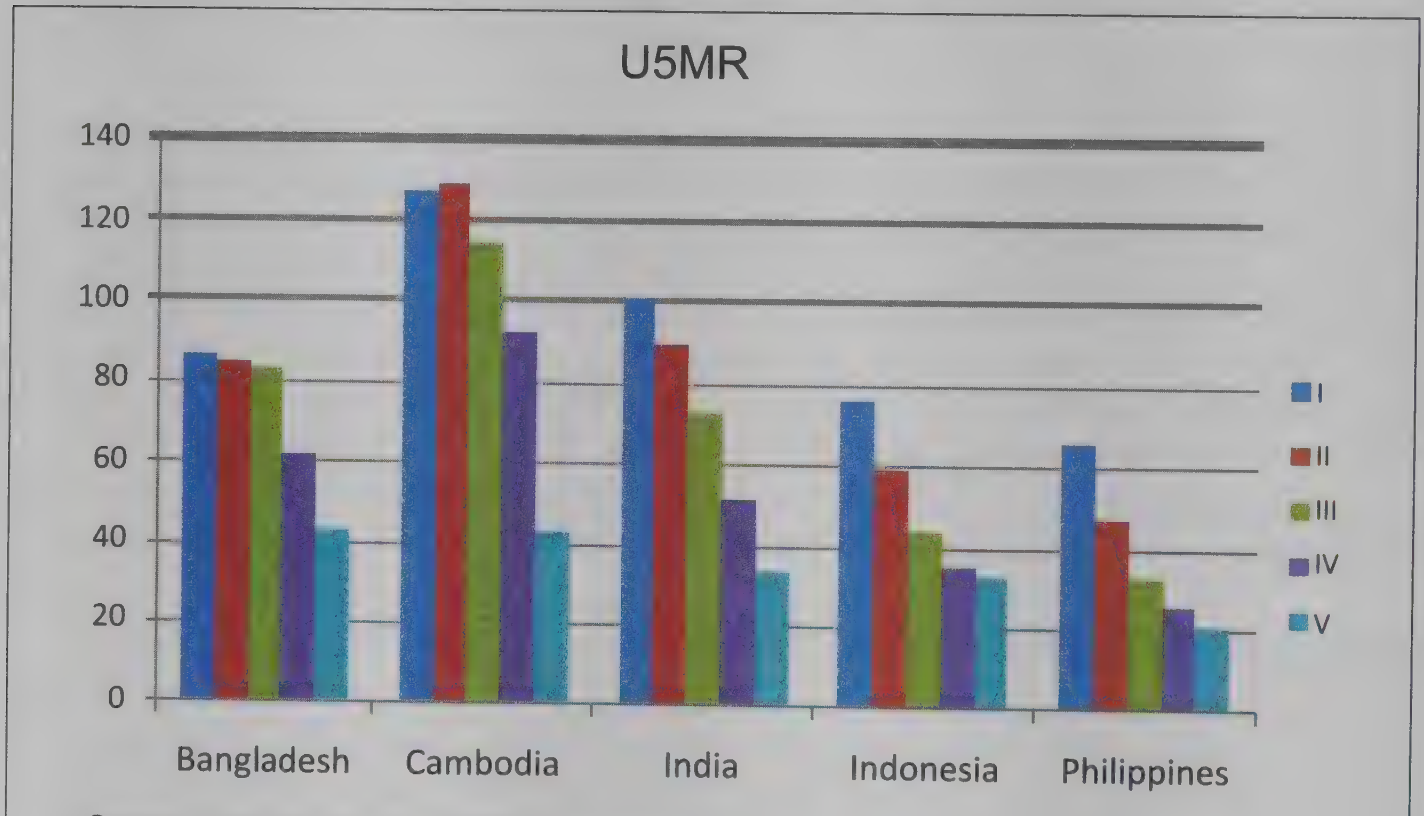
Source: WHO 2007 data

Figure 2: Health is still a matter of wealth: MMR among countries



Source: UNFPA, State of World Population 2008

Figure 3. Health is still a matter of wealth



Source: DHS Bangladesh 2007, Cambodia 2005, India NFHS3, Indonesia 2007, Philippines 2003

In almost any health problem that one wishes to address, there are some leadership tasks and some management tasks that need to be carried out although their mix may vary. If a programme is in maintenance phase, then relatively much more of management tasks are required. In a health problem that is evolving, there is much more need for leadership tasks compared to management tasks. If this balance is not right, the success in addressing that health problem would be suboptimal.

Progress in improving health and reducing health inequalities has been slow and if there is a continuation of what has been done, the result will again be slow progress. If one wants to accelerate

Fig. 4: Strategic leadership framework

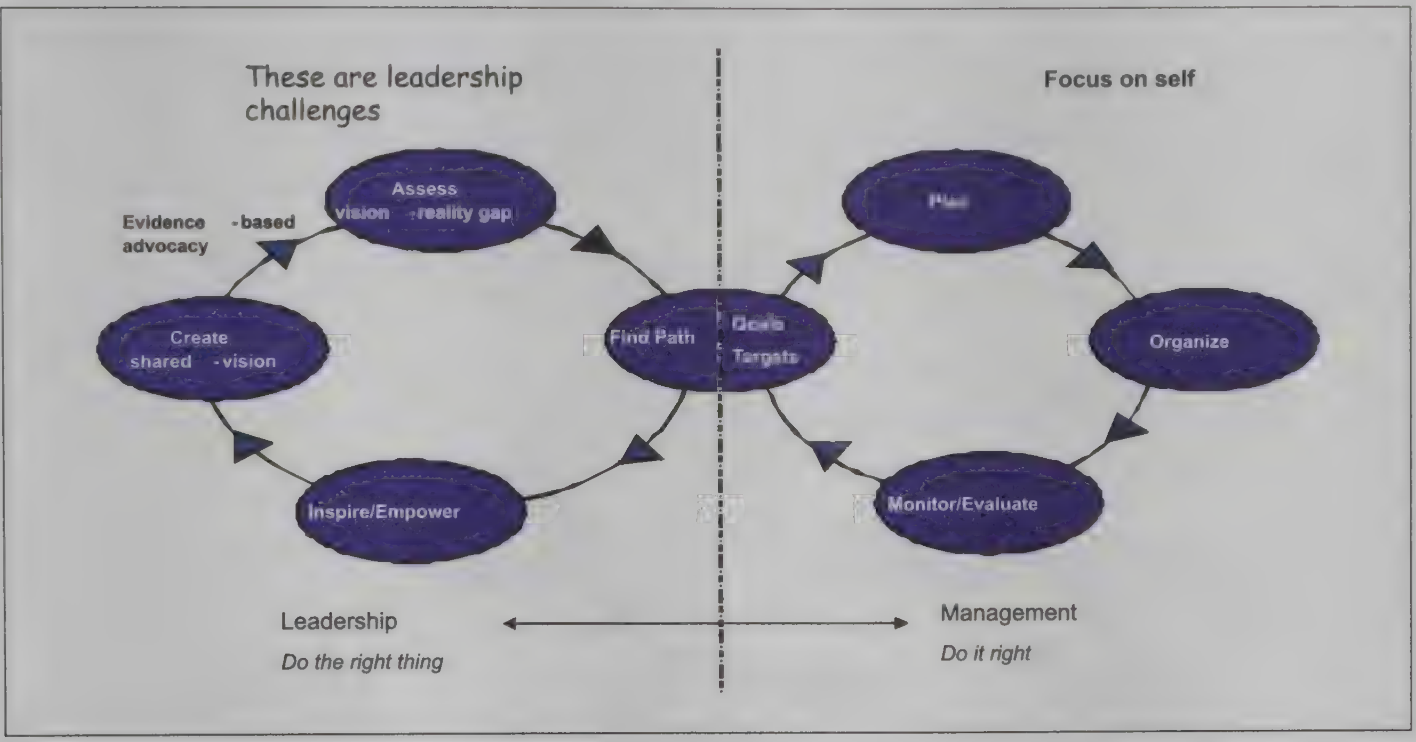
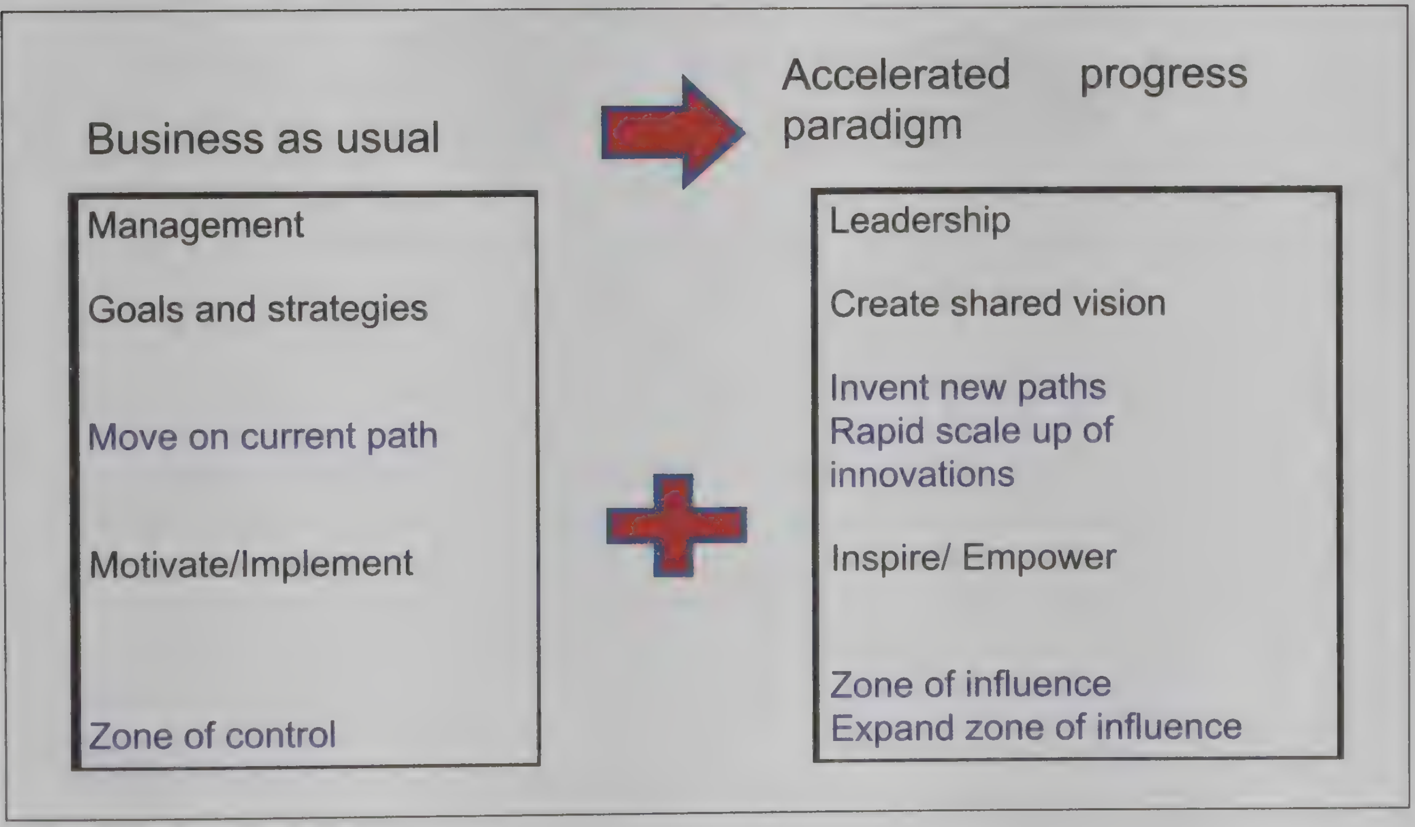


Figure 5. Accelerated Progress Paradigm

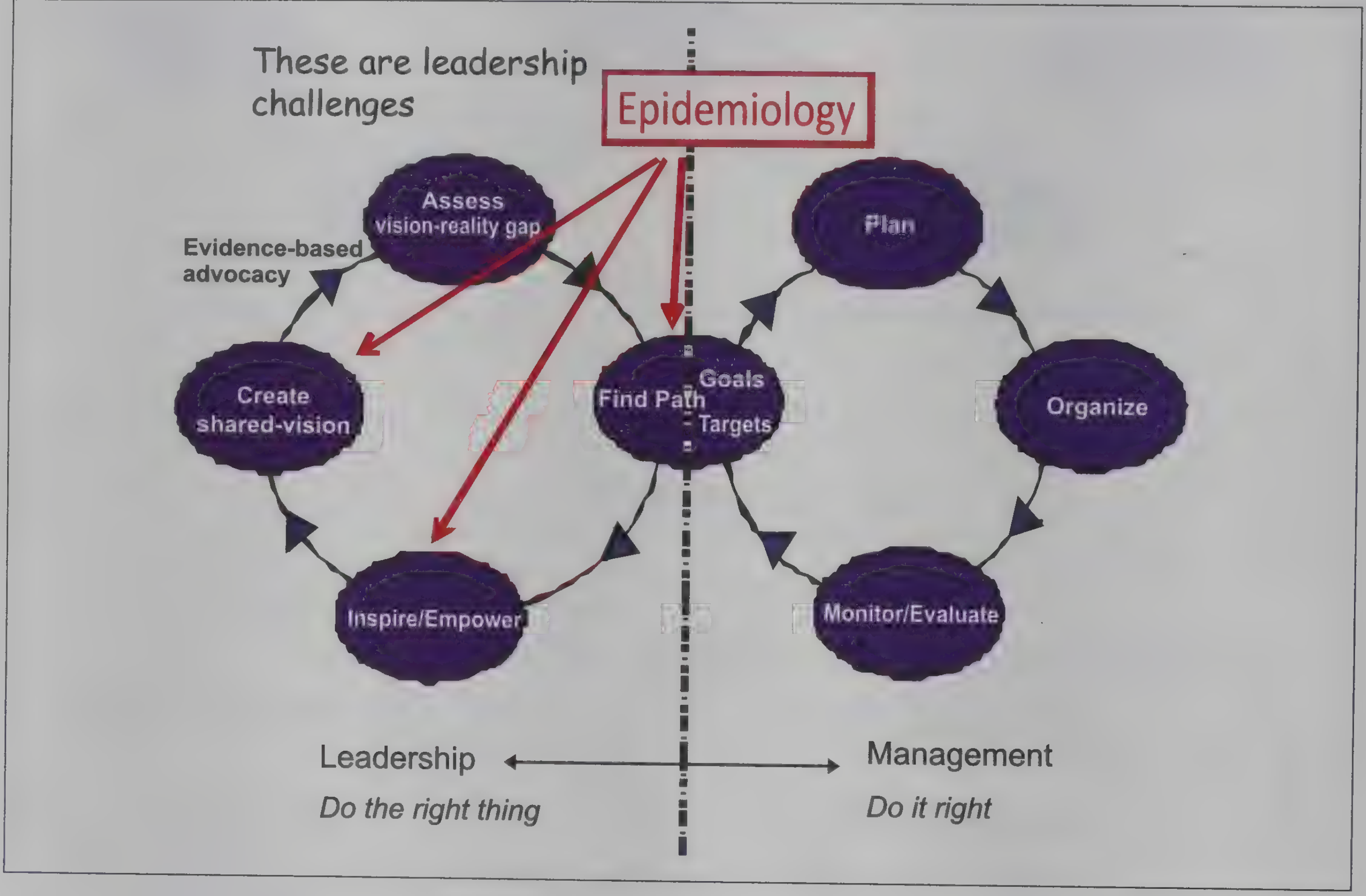


progress, a right mix of management and leadership is needed (Fig. 5). Instead of just talking about goals and strategies one has to see if a shared vision has been created among key stakeholders. Instead of just doing what has been done, new paths have to be devised for a rapid scale up of innovations. Instead of talking about motivating and implementing, one should think of inspiring and empowering stakeholders. Most health sector managers operate within their zone of control. However, many health problems require an intersectoral approach. Therefore, leadership is required both to expand and move from zone of control to zone of influence. Strategic leadership complementing leadership and management is needed to move from 'business as usual' to 'accelerated progress paradigm'.

How can epidemiology help?

Epidemiologists help the management as they look at indicators for setting goals and targets and to monitor and evaluate. However, they can also assist leadership in health (Fig.6). First, epidemiology can help in creating a shared vision. Secondly, epidemiologists should not work only with a single disease but with a cluster of diseases like noncommunicable diseases or vector-borne diseases which

Figure 6: Epidemiology and leadership connection



may have lifestyle or vectors as a major cause. Rather than just addressing epidemiology of malaria, one could also address chikungunya, dengue, etc., to create a shared vision. From a single disease focus, epidemiologists need to move to a whole set of diseases which may have some commonality, a common cause or a common transmission agent. This would not only assist in taking care of a shared vision and assessing vision-reality gap but also inventing new paths by identifying commonality among a set of diseases. For instance, hand washing can address H1N1 but hand washing also prevents diarrhoea and some other diseases. One needs to communicate the results not only to professionals but also to stakeholders so that they are empowered and inspired to act. This again is a challenge. For instance, communicating the risk of H1N1 to people was a big challenge. One has to learn the language which people will understand and would act upon to improve their health.

In summary, there is a need to strengthen strategic leadership at all levels – top, middle and grass roots. However, leadership development is not easy. The commercial sector puts in a lot of effort for leadership development.. Health sector also needs to do so. A blended approach is needed for leadership development which should include training, mentoring, coaching, on-the-job support, exchange and networking. This is not easy and that may be the reason why progress in leadership development in the health sector is slow. It is a challenge to move from 'business as usual' to 'accelerated progress paradigm', which needs to be addressed so as to have a healthy future for all people.

Leadership, management and epidemiology: issues at country level

Tee Ah Sian

Translation of epidemiological knowledge or evidence into public health action is an essential prerequisite for success of public health programmes. Public health refers to the collective actions to improve population health needs. Epidemiology in fact is a very important discipline which provides evidence for public health leaders to take action. Epidemiology is not just the traditional study of the distribution or the determinants of health-related states or events but its most important aspect is the ability to apply it directly to solve a local health problem. It is not so easy for leaders to turn the observation data into preventive action. It requires bold leadership and a real paradigm shift in thinking.

There are several examples of how observational data were actually used for public health action. Way back in the 18th century, Edward Jenner made an observation regarding very low incidence of smallpox among dairy maids. Following the initial observation, more studies were carried out and ultimately observational data led to the development of a vaccine for smallpox. The global leadership took it further and eventually eradicated smallpox in 1977. There is also a very famous study of the association between smoking and lung cancer. World leadership put in place control measures, and convinced countries to sign on to the WHO Framework Convention on Tobacco Control (FCTC).

Epidemiology actually provides a sound and rational foundation for public health leaders to develop public policies and make meaningful decisions. There are many examples of how a sound evidence-base led to recommendations such as the use of seats belts while driving, screening for breast and cervical cancer, folic acid supplementation during pregnancy, and vitamin A supplementation for children. Over the years, the concept of epidemiology has taken a slightly different slant and is utilized to evaluate new preventive and therapeutic measures, and also new modes of health care delivery, for example, there is an initiative to re-evaluate screening strategies for cervical cancer in developing countries. After years of efforts to implement cervical cancer screening as recommended in developed countries, many programme managers in developing countries have learned that this is not feasible in developing countries because of weaker health systems and due to cultural considerations. There is now a move to try and see whether making use of a single visit of a woman using a visual examination would replace the taking of a Pap Smear which used to require a cytology laboratory. This is the use of epidemiology for evaluating new health care methods. Efforts are now underway to develop malaria and HIV vaccines which can not be applied across the board; for different countries different methodology would have to be used.

Epidemiology should also help bridge the gap in biological knowledge and enable public health leaders to take public health action. The absence of biological knowledge should not hinder or prevent the implementation of effective preventive services. One very good example is rheumatic fever. The biological basis for rheumatic fever is not known. Only some children have rheumatic fever when

many have streptococcal throat infections. Epidemiological studies have shown that effective and prompt treatment of group A streptococcal throat infections prevents the development of rheumatic fever. Sometimes one does not really require in-depth biological knowledge. As another example we administer hepatitis vaccine immediately upon birth to babies who are exposed to infected mothers. This also prevents the development of chronic hepatitis B in children later. These observational studies show that interventions can be implemented without having full biological knowledge. Public health policy makers should be able to implement effective community and public health programmes even if it is based on available observational data.

Leadership is required at all levels, i.e., community, national, and international levels for translation of epidemiological information and evidence into public health actions. Leadership will be required to identify priorities for determining what kind of new studies need to be designed in order to answer local questions. Unless local questions are studied and unless appropriate research is targeted at local problems, there won't be local ownership and implementation as well. Leadership is necessary to apply epidemiological evidence to health policies in a timely manner. There have been too many examples in history where there have been delays between acquisition of epidemiological evidence to its translation into public health action. A good example is smallpox vaccine and smallpox eradication. It took about 200 years from the time the vaccine was available to eradication. Of course, poor leadership has also been pointed out in some neglected cases even now. Although there is general agreement that disease surveillance is a very important component of public health, there is, however; minimal use of surveillance data for policy making. Because of the minimal usage of data, there is hardly any effort to make sure that the data collected is of good quality. Rich information from surveys is hardly used and it remains on the shelves of researchers. Leadership is very important to research initiation as well. One has to advocate for translation of research into polices. Leadership must make a link between the discipline of public health practice and population-oriented health research.

Epidemiology can be used by public health leaders because epidemiology provides a rational basis for allocating resources. Before one can advocate for interventions, one needs to be able to argue why those interventions are being recommended. Epidemiology supports evaluation of different health options to solve a particular health problem. Public health leaders must have the ability to find, understand and interpret epidemiological results and make the best use of them. Epidemiology can be a tool for programme managers also because through epidemiology they can evaluate how services are being delivered and try to improve the delivery of different kinds of health services. Epidemiology can also support programme managers in choosing new, preventive and therapeutic measures. For programme managers, disease surveillance is a very important area as data generated from disease surveillance helps in assessment of the performance on an ongoing basis. Epidemiology, of course, is needed to detect and control disease outbreaks.

There are many groups, and policy makers, programme managers, researchers, epidemiologists and the community, civil society, and NGOs etc. engaged in health work. The key question is how to bring different groups together so that each and every one of them can understand and have a common knowledge of how to use epidemiology, how to use the evidence that is available, and apply it to decision making. Researchers are very interested in academic results, and this is how policy makers perceive them. On the other hand the researchers think that policy makers do not understand what they do. Then you have the community who think that researchers and policy makers make policy out of no where; without having any evidence, and then try to force down their decisions. In order to bring all these stakeholders together, WHO launched the evidence informed policy network (EVIPNet) in 2005. This is an attempt to bring all partners together around the table where they can debate about the evidence that is existing, and the kind of research that needs to be done etc. This type of forum is very much needed where people can understand what each member of the group is doing. The

other objective is that this network can also facilitate in developing policy briefs and present them to decision makers. The network can also monitor and evaluate data and also track the progress to improve translation of research into policy action.

The WHO Western Pacific Region has already launched EVIPNet. Five countries are into this network. They have committees having representation from different types of professionals and also the civil society. They go through the debate on existing research evidence and pick up the ones which they think can be translated into action. The formulation of national teams with different professionals works quite well. The WHO Regional Office was networked with them to provide an opportunity to share good practices across different countries.

EVIPNet Asia is still in its infancy, though team formulation at the country level has been done. More work is needed. The WHO Regional Office for Western Pacific Region has undertaken some training for the national teams to build up their capacity in order to do a systematic review on the existing research evidence that is available in each of the countries. This network will also continue to facilitate the development of country policy briefs and follow-up the programme. EVIPNet is an attempt to provide a forum for discussion on research, policy development, and actions. In the next three years, more countries are likely to come on board. Then, the sharing of best practices and interventions can also happen on a larger scale.

Management modules in epidemiology training to strengthen health systems: experience of the Master's in Applied Epidemiology programme at the National Institute of Epidemiology, Chennai, India

Yvan Hutin

There are various accepted definitions of 'leadership' and 'management'. Using a simple perspective, leadership can be defined as doing the right things, whereas management is more about doing the things right. Leadership may be difficult to teach; however, management modules may be included in training programmes designed to build competencies in field epidemiology.

Training programmes in epidemiology address theoretical and/or applied concepts of the use of data for decision-making. Thus, some may not address the management aspects that are needed to increase the effectiveness and efficiency of public health programmes. In the context of the Indian Field Epidemiology Training Programme (FETP) [Master's in Applied Epidemiology (MAE) from the National Institute of Epidemiology (NIE), Chennai, Tamil Nadu, India], a management module was developed in collaboration with the Centers for Disease Control and Prevention's (CDC) Sustainable Management Development Program (SMDP). The FETP-MAE is a two-year programme designed to generate seven core competencies in applied epidemiology. FETPs were developed on the model of the CDC's Epidemic Intelligence Service (EIS). The programme consists of: (1) six months of training at the institute (spread over a duration of two years, with a three-month induction course followed by three one-month contact sessions); and (2) 18 months of practice in a district of assignment, under the "learning by doing principle". During this programme, seven core competencies are developed. These are: (1) epidemiology; (2) surveillance; (3) outbreaks; (4) research; (5) human subjects' protection; (6) communication; and (7) programme management.

The management module (seventh core competency) is based on the concept of the (a) assess, (b) plan, (c) implement, and (d) evaluate, cycle. It has three sub-competencies. The first is to conduct a situation analysis with respect to the Millennium Development Goals. As part of that assignment conducted at the beginning of the course, scholars frame their epidemiological work in a way that would serve the health system rather than just generate academic reports. The second is to manage people and resources, with a focus on project management. Scholars use the opportunity of their final thesis to apply the principles they had learnt while managing the organization of their field work. The third is to evaluate public health programmes, with a focus on logical framework and development of input, process, output and outcome indicators. One of the mandatory reports to be produced in order to graduate from the programme is an evaluation of a public health programme that uses the recommended framework to evaluate public health programmes (engage stakeholders, describe the programme, focus the evaluation design, gather credible evidence, justify conclusions

Mini contact session of the FETP scholars

and ensure use) as published in a special issue of the Mortality and Morbidity Weekly Report. Quality assurance measures while managing the training programme and its management module include: (a) documentation of all procedures, with peer review process; (b) continuous assessment by the faculty of the acquisition of the competencies by the scholars; and (c) regular evaluation of the learning activities by the scholars. Of the 80 scholars who joined the programme during 2001-2007, 69 (86%) completed it. Of those, all produced at least one situation analysis and a programme evaluation report. The results of a survey of the NIE graduates conducted in 2009 suggested that most graduates' skills in management had increased from being 'aware' (i.e. has been exposed) to being 'proficient' (i.e. experience in the field to the point that one can implement without supervision). The limitations of the approach are that (1) everyone cannot be a leader; (2) some people will not be placed in managerial positions; and (3) the FETP course keeps a primary focus on field epidemiology; hence, it cannot address everything.

Inclusion of a management core competency in the FETP course increased the skills of the scholars in these disciplines. More importantly, as per the 'learning through service' concepts, the field assignments helped bridge the FETP experience with the health system through a client-focused situation analysis that served local decision-makers and the delivery of a programme evaluation report that could be acted upon. Additional efforts are needed to: (1) further refine these modules through continuous quality improvement to maximize benefit to the health system; and (2) scale up this kind of approach for use in more epidemiology training courses. Lastly, supplemental management modules could be considered as add-ons to the programme for those graduates who might need them.

Leadership and management training course for tuberculosis control

Saroj S Jha

Current achievements of national TB control programmes are impressive. Much of the efforts that have gone into the programme focused on aspects like training in upgrading technical capacities, implementing DOTS, improving laboratory services, refining case management and so on. A critical dimension found missing or inadequately covered, has been training in "leadership and management" which is today recognized as a key component of all health programmes, whether TB or otherwise, "management" in this case refers to "staff and team management" which is so vital for the success of a programme. Technically programme managers are excellent, but are they also good leaders, possessing the required managerial skills to guide their teams to effectively address the overwhelming challenges that TB presents?

These were questions that prompted the South-East Asia Regional Office of WHO to carry out an assessment of leadership and management skills required at national and international levels. As an outcome of this review it was agreed that there was a clear need for developing a training course on leadership and management.

The Course was developed through several workshops and consultations conducted jointly by SEARO in collaboration with the Indian Institute of Health Management and Research in Jaipur. TB programme managers from the Region, as well as experts, from the Region and outside participated in this process and the outcome of these consultations was production the "Leadership and Management Course for TB Programme Managers". Salient features of the course are:

- it comprises eight training modules, each clearly specifying the training objectives,
- use of a wide variety of training methodologies,
- promotion of self learning,
- encouragment to participants to be independent and self directed; primary role of facilitators is to guide participants to gain additional knowledge and skills,
- each module can be used independently if it is not possible or necessary to use them as a package,
- extensively field tested in the countries of the South East Asia Region

Course Modules

Module 1. Introduction to the Course

It provides an overall statement for the need for such training and the methods used to facilitate it, and stresses on the conviction that effective leadership and management lays the foundation for a strong and sustained TB Control Programme

Module 2. Managerial styles

Managerial style as described in the module, is the way to interact with and provide guidance to staff and colleagues. The module:

- explains in detail what is meant by "Management Styles",
- lists six managerial functions: nurturing, regulating, task management, creative, adaptive and reactive and helps participants to recognize their managerial style against each of these functions, through interesting written exercises,
- describes 12 management styles: supportive, rescuing, normative, prescriptive, problem-solving, task- obsessive, innovative, bohemian, resilient, sulking, assertive and aggressive.
- Answers if you are in OK or Not OK positions. OK position means you have confidence in your staff in understanding instructions, meeting deadlines, coming up with new ideas, etc. and this influences your management style. Not OK position means you have less capable staff and therefore your management style becomes different.
- Guides you in changing your style to move from "not ok" to "ok" positions.

A number of intricate but interesting exercises followed by group discussions are used in this module to help participants improve their management style. It also tells that you may have more than one style. The style you use frequently is called the dominant style and the style you use most, other than your dominant style, is called your back up style.

Module 3. Leadership and leadership styles

Leadership as described in the module is a process or ability to motivate and mobilize others to work together to achieve a common goal. The leadership module helps to :

- understand what makes a good leader,
- identify your leadership style, whether it is supportive or directive,
- assess the development level of your team, their competence, commitment and team work,
- adapt your style to become a more effective leader,

A frequent question asked is "what is the difference between management and leadership.

A simple explanation offered is that management deals with administrative aspects such as planning, organizing and monitoring. Leadership on the other hand deals with interpersonal aspects, like inspiration, motivation, and influence. As in the previous module, written exercises followed by group discussions take place throughout this module.

Module 4. Personal effectiveness

Personal effectiveness is a measure of what effect you have on others, is it confidence, fear, trust etc. It is dependent on understanding yourself and others, thereby contributing to the overall effectiveness of yourself as well as the team. The personal effectiveness module helps to:

- understand the dimensions of personal effectiveness: self awareness, perceptiveness, self disclosure and feedback
- grade your own personal effectiveness and the category you belong to. Various categories of personal effectiveness have been described, ranging from effective to ineffective, depending on how high or how low you are on self disclosure, use of feed back and perceptiveness. There

are many written exercises in this module which lead participants to be aware both of their strengths and weaknesses. For some this comes as no surprise. For others there is utter shock and dismay!

- identify ways to increase your own personal effectiveness and that of your staff

Module 5. Role efficacy

Role efficacy is the effectiveness of an individual occupying a particular position in an organization. In a system, "position" refers to the title or designation given while "role" on other hand is defined by the tasks and functions given. Each team member has a role to play in achieving the programme's goal. How do we make that role more efficacious? How do we generate motivation to make staff work more effectively? There are several exercises in this module that tell you how both you and your staff can be made more effective, especially to cope with stresses and show commitment to their work. The role efficacy module helps to:

- understand the concept of role efficacy,
- examine the efficacy of the roles of staff,
- develop specific action points to enhance role efficacy.

Module 6. Communication Skills

Communication is a process by which we interact with each other. It is part of every function of management. The module focuses on interpersonal communication, the kind of which is continuously taking place in a work environment. What a Manager communicates to his or her staff is obviously very important. But How it is communicated is equally if not more important

The communication module helps to:

- understand the communication process, and the different channels of interpersonal communication,
- identify the barriers to effective communication,
- improve your communication skills.

Barriers to communication and ways to improve ones skills are brought out through entertaining exercises including role play and games

Module 7. Team building

Team building involves transforming a group of individuals into a team by clarifying objectives, planning operations with consensus, coordinating resources and getting things done together, despite obstacles, stress and demanding pressures.

Essential components of a team are working for a common goal, interdependence, commitment and accountability. The team building module guides participants through the various stages of team building, leading and enhancing the effectiveness of a team,

Through a number of exercises including a game and case study the importance of working as a team is brought out through individual written exercises the role and responsibilities of each member of the participant's team is spelt out. The stages of team building are explained and through a review of the team work now existing, participants are helped to prepare action points for strengthening team work in their programmes

Module 8. Building Partnerships

Effective TB control needs partners since the public health system alone would be unable to address the wide range of issues involved. Building partnerships is a dynamic process aimed to maximize benefits. The partnership building module helps to:

- understand the characteristics of successful partnerships
- identify the potential and possible roles of various partners; partnerships could be built with the public sector, with the private sector, with academic institutions, with media, with the community and so on. The list is endless.
- take key steps in building partnerships.

The key steps in building partnerships are arrived after a series of exercises are carried out which includes conducting a situational analysis, analyzing potential partners through SWOT analysis, short listing, networking, capacity building etc. and preparing action points for enhancing and sustaining partnerships.

Learning methodologies

Learning methodologies are aimed towards self learning and active involvement of participants in the learning process through modular reading. Participants in small groups read the specific module to get acquainted with the topic, seek clarification if needed from each other and /or from the facilitator. This is followed by a plenary presentation made by a facilitator to further clarify concepts, reiterate the importance of the topic, its learning objectives and the training methodologies that will be applied to achieve them.

Plenary sessions are held throughout all modules. Apart from the initial introduction to the module, presentations are especially required when concepts described are unfamiliar and when group work is shared.

Small group discussions take place throughout the modules especially after individual exercises are carried out, to share responses and other experiences related to the exercise, among group members. In some modules, exercises are conducted as group work for example in the module on building partnerships to identify which partnerships would be useful based on the previous experience of participants.

Case studies are used when relevant such as in the modules on team building and partnerships. Brain storming is encouraged throughout the course to promote participatory learning.

Extensive individual and group written exercises play a critical part in the learning process. Role play and games are especially useful in the modules related to communications and team building.

Finally, my own observations and experiences while participating in the development of this course are that the learning process was unique. It was interactive all the way. It enabled participants to do some serious introspection on the way they were managing their programmes as well as to recognize their strengths as also their limitations in a very objective and non threatening way. The course also guided them on how they can enhance their skills to become more efficient managers and leaders. The extensive exercises provided a whole new dimension to the learning process. They were interesting, thought provoking, revealing and also a lot of fun.

Since all disease control programmes require good management and effective leadership, these modules with appropriate modifications could well serve as a useful tool not merely for TB but for training in many other health programmes and projects.

Section 5

Skill Building

Research methods

Chairpersons: *Roger Detels*
Sujit Bhattacharya

Session Coordinator: *Sujit Bhattarcharya*

Health research: concepts, methods and techniques – *Raina MacIntyre*

How to write a research proposal?
– *Soumya Swaminathan*

Epidemiological research and methodological issues – *J P Muliyil*

Health research: concepts, methods and techniques

Raina MacIntyre

Epidemiology was born in the 19th century. John Snow was involved in the cholera outbreaks in New Castle-on-Tyne, UK, in 1832 and 1853 and during the London epidemic of 1848. He published a pamphlet on the mode of communication of cholera. He carried out really what is historically the first thorough epidemiological investigation, and determined that the source of cholera was contaminated water from the river Thames. He published a second pamphlet in 1855 with his theory that cholera was spread by the faecal-oral route and from person to person, and determined that defective sewage resulted in the contamination of wells and water. The germ theory of cholera was proved in 1833 by Robert Koch, who isolated the Vibrio cholerae. At the same time, William Budd also came up with the same conclusions about the aetiology of cholera. He also published studies on typhoid fever in *Lancet* and *British Medical Journal*.

From there, epidemiology has developed as a discipline, with multiple methodologies available for use for scientific inquiry. The three major categories of studies are: descriptive studies, observational epidemiological studies (including cohort and case-control studies) and interventional studies (including randomized controlled clinical trials). The most suitable study depends on the type of research question – for example, randomized controlled trials (RCTs) are suitable for questions of therapy or prevention but cannot answer questions on aetiology. For the latter, we need observational epidemiological methods. The descriptive epidemiological studies are considered to be a lower level of evidence but they certainly have their place. Correlation studies are particularly important for looking at the interaction of environmental factors and disease, such as the relationship of weather patterns or climate change to infectious diseases. Case series and case reports have made important contributions to new knowledge, particularly with the emergence of new diseases. For example, HIV was first documented in a case series of syndrome of unusual clusters of a new disease syndrome. Cross-sectional surveys do have importance, particularly in establishing prevalence of a disease.

People who know a little of evidence-based medicine (EBM) tend to think that case-control studies are not useful. In case-control studies subjects are selected on the basis of disease status and they are then compared for the exposure of interest with controls. There are several issues in the design of case-control studies, including case definition. There could be a series of definitions of definite, possible and probable cases. Selection of controls and where to select them is another issue. Matching is popular to control confounding but one may overmatch in case-control studies. Some are in favour of unmatched case-control studies and there are reasons for that. There are issues around the ascertainment of disease and exposure status, which can critically affect the results. The major issues in analysis of case-control studies are biases, particularly the selection bias. One can only get an odds ratio from a case-control study but cannot get a relative risk because there is no time dimension in the data. Case-control studies without an a priori hypothesis end up as a fishing expedition which can produce questionable results. The strengths of case-control studies are that they are quick and efficient. They

are very good for studying rare diseases or diseases of a long latent period. They can determine multiple aetiologies and are efficient for rare exposures. They cannot determine incidence or temporal relationships and are prone to bias. One of the classic case-control studies in history is the study of smoking and lung cancer by Richard Doll and Austin Bradford Hill, which showed the association between smoking and lung cancer. Other classic case-control studies are those on toxic shock syndrome and tampons, diethylstilbestrol and vaginal cancer, asbestos and mesothelioma, and vinyl chloride and angiosarcoma of the liver.

In cohort studies, groups are defined on the basis of exposure, which are then followed up for the development of the disease of interest. They can either be retrospective or prospective. The retrospective design has more limitations than the prospective design. The retrospective design, however, is suitable for diseases with long latency. One can have a nested case-control study within a cohort study. There are issues about selection of the comparison cohort, classification of exposure and disease status, and sources of data on disease/outcomes and on exposure and how subjects are followed up. One can calculate incidence with the cohort studies; therefore, it is possible to obtain a relative risk. Confounding and bias can still be issues but bias is much less likely in a prospective cohort study compared to a case-control study, but loss to follow-up can affect results quite significantly. The strengths are: one can look at rare exposure, examine multiple effects of a single exposure, measure incidence, and if it is a prospective cohort, there is less bias. The limitations are that it is inefficient for rare diseases and can be very time-consuming and expensive. Some classic cohort studies are Framingham heart study and the nurses' health study.

There are some further issues in field epidemiology. How to do a thorough outbreak investigation using the case-control methodology for determining the risk factors for disease? The quality of field epidemiology training programmes (FETP) depends on where the field placements are and who the supervisors are. It is really important that trainees learn how to use case-control methodology appropriately to determine risk factors while investigating an outbreak.

Regarding interventional studies, the focus is mainly on randomized control clinical trials. Basically, randomization is designed to eliminate the effect of confounding so that complex patient groups can be studied. It is assumed that if randomization is done correctly, then distribution of confounders between arms would be equal. Cluster randomization is a particular methodological issue. Probably, cluster randomization can be done by families, hospitals, communities, villages or other units of existence. Cluster design is at times considered for reasons of equity. However, there is loss of statistical precision in cluster trials. If one can measure variables and find that they are equally distributed, then randomization is successful. The double-blinded placebo- controlled designs are considered ideal. Blinding reduces the risk of bias and the placebo measures the placebo effect and also helps in assessing the true adverse event rates if it is a drug trial. Multi-arm trials are common. The intention to treat analysis is the gold standard.

Ethics becomes a really important issue in RCT, particularly getting written informed consent. These days it is a requirement for studies to get published in a journal to have it gone through a proper process of obtaining ethics approval. One needs to consider issues of risk versus benefit, the principal of avoidance of pain and suffering, privacy, and not using samples collected in trials for anything other than what was approved by ethics committee. Not falsifying results sounds simple, but there have been some very notorious cases of people who have done this. Sometimes, mistakes do happen while conducting clinical research. The key point here is open disclosure when a breach of ethics happens.

Trial registration is another important issue. This has come about because of suppression of negative findings by the pharmaceutical industry. Now, one cannot get a trial published unless it is registered. Investigator-driven trials are much harder to conduct than the wholly-funded industry trials.

The pitfalls of RCTs are that one has to make sure that randomization is secure. Certainly, there should be staff to check on the randomization. The standard now is secure computerized randomization. Check the data regularly and make sure to know the data. Data collection is an issue in follow-up and for measurement of end-points. Intent to treat analyses is the gold standard. In some cases, one can do subgroup analyses. Adverse-events monitoring is an important issue and there should be procedures for un-blinding in case of adverse events. Post-marketing surveillance can pick up rare adverse events.

Health economic analysis, mathematical modelling, health system and social and behavioural research studies should not be conducted in isolation but one should have a multidisciplinary approach. Finally, one should try to translate evidence into policy and practice. Hence, there should be a close relationship between epidemiology, academics and policy-makers in multidisciplinary environments.

There are several levels of evidence for RCTs. Level-I evidence is obtained from systematic review or meta-analysis of all relevant randomized control trials. Systematic review is great but these reviews are also subject to the same critical analysis that individual studies should be. There are many examples of systematic reviews that have serious flaws. One needs to look at everything critically as to how the data was collected and who did the review. Was it an expert on the disease or was it someone who has made an industry of doing meta-analysis? Level-II evidence is from at least one properly designed RCT. Level-III-1 evidence is from a well-designed pseudo-randomized controlled trial. Level-III-2 evidence is from comparative studies with concurrent controls and allocation not randomized, including cohort, case-control and interrupted time-series studies. Level-III-3 evidence is from comparative studies with historical controls, two or more single-arm studies and interrupted time-series without a parallel control group. Level-IV evidence is from cases series, either pre-test or pre-test and post-test. If it is a health economics study, there is a set of criteria for evaluating those which are different from the meta-analysis of RCTs.

Evidence-based medicine has been a craze in the world for the last 20 years. However, still many people think of the level of evidence as being valid and high from intervention studies only. One may ask the question: does smoking cause lung cancer? The answer would be that there is not even a single meta-analysis; therefore, the level of evidence is low and smoking does not cause lung cancer. In truth, the question cannot be answered by a RCT, as it is a question of aetiology. Another question could be: whether school closure is effective in a pandemic? The answer would be: as there is not even a single meta-analysis, it is not effective. The truth is that this question is about a hypothetical future scenario and cannot be answered by a RCT. This brings us back to the research question. One needs to think what the research question is? Is the question epidemiological in nature, i.e. aetiology, diagnostic accuracy, prognosis, screening, therapy or future event? Randomized control trials are only appropriate for questions of therapy or prevention but not for other types of questions such as smoking and lung cancer, which are better answered by descriptive epidemiological or analytical studies.

How to write a research proposal?

Soumya Swaminathan

There are several challenges in writing a research proposal. But the first question is: why undertake research? Medical colleges in the WHO South-East Asia Region are really not doing as much research as they could or should be doing. This is an area with a lot of scope. Senior faculty should encourage their junior colleagues and students to do research.

There are many reasons why one should be doing research. Firstly, research advances basic knowledge, allows for ongoing improvements in therapeutic, preventive and diagnostic strategies and identifies and addresses gaps and challenges in health care delivery (Box 1). For programme managers, a research question could be anything from a very upstream issue like lack of proper diagnostics or a drug to a very downstream issue of implementation of the health care programme. Research within policy and programme helps to support programmatic changes. It provides feedback to personnel who are involved in carrying out the work and can motivate them to actually change practices. It has been shown time and again that investment in research for health is directly linked to economic development as well as to improved health care delivery.

Box 1: Why undertake research?

- Advances basic knowledge in the field.
- Allows for ongoing improvement in diagnostic, preventive and therapeutic strategies.
- Identifies and addresses gaps and challenges in health c are delivery (upstream to downstream).
- Supports programme and policy-decisions.
- Provides feedback to personnel and can motivate them to change practices.
- Investment in research is directly linked to economic development and improved health care delivery.

Nowadays, there is more emphasis on operational research or implementation research. Many conferences used to have just clinical, behavioural or basic research track but now they have operational and implementation research tracks as well. The goal is to provide an assessment of programme designs, operations and outcomes. It is very useful to conduct this type of research when there are sudden changes in policies or programmes.

What does implementation research do? It asks the following questions: what is happening in the programme? Is this what is expected or desired? Is this the kind of outcome wanted? Are the cure rates proper or is a vaccine working? Or is a particular strategy working? This is what implementation research will answer. It can address almost any phenomenon that is related to the way a programme

operates. Therefore, there are a wide range of data collection strategies ranging from interview surveys to focus-group discussions, both quantitative and qualitative types of data collection, participant observation as well as use of routinely collected data and records.

There are several advantages of implementation research. It provides rapid feedback to programme managers. It provides information during a programme's formative phase. Suppose, suddenly, a programme is to be launched like the 3by5 Initiative for HIV treatment; there are only a few months for the government to get going. If one wants quick information and/or feedback on how the programme is doing, implementation research would help. It would provide a lot of rich contextual information by ethnographic and qualitative data collection. It would provide information about the programme as it really is, as opposed to, say, a randomized clinical trial which is done under very controlled settings. It provides limited and strategic information where and when necessary. However, there are limitations to the value of implementation research. It does not provide a direct and accurate estimate of the programme impact because it is not looking at a long period of time for the impact or cost-effectiveness. And it does make judgements on the basis of some qualitative data.

Why write a research grant proposal? Basically, grant applications are prepared to do research in order to question the status quo, to determine what is happening, or to test a hypothesis. Research grants allow one to obtain additional resources such as personnel, which may not be available in the institution or within the department, for undertaking research. Regular full-time faculty members may not have the time to commit fully to research; therefore, a research grant will give a chance to employ personnel, buy equipment or consumables, or travel to conferences, etc. These types of resources can be obtained from a grant. Of course, research will also be useful for the future career and enhanced professional recognition of the person(s) undertaking research.

A research idea should fill a gap in knowledge and it should be important. It should be important to the institution, probably to the country, or to the people as a whole. It should also fit into the priorities of the funding agency and the reviewers. It is important to keep in mind the kind of grant that is being submitted. It should test a hypothesis. And short-term investment should lead to long-term gain in terms of impact and sustainability (Box 2).

Box 2: Components of a research idea

- Fills a gap in knowledge.
- Is important
    - ◊ To you and your long-term career path;
    - ◊ To your institution;
    - ◊ To the field;
    - ◊ To the funding agency;
    - ◊ To the reviewers.
- Tests a hypothesis.
- Short-term investment leads to long-term gain.
- Makes an impact.
- Is sustainabile.

The first thing is the research idea. Where do ideas come from? Quite often, they would come from clinical observations. If a patient had a particular phenomenon, then make a start with a case series and then go on to more in-depth research. Ideas can come from the literature or from presentations at professional meetings, or discussions with colleagues. It could be an emerging health-related issue,

new infection or a disease observed in the field which probably would interest an epidemiologist. It could also be programmatic issues and challenges. For example, if, in spite of all efforts, the cure rate for TB does not go up beyond a certain point, or the case-finding is not improving, one can try to find out why that really is. Another question can be, what kind of health problems are there within a specific region or country? Translational research means taking something from the bench to the bedside and then into the field. Behavioural science aspects have really become quite popular. Population genetics and genetic epidemiology is an emerging field because every ethnic group would behave in a different way for certain treatment or drugs that are being used.

After determining the research question, planning is to be accomplished. Research question should be based on gaps in the literature, which means the literature should be studied, and one must specify why is the research compelling, timely and necessary. What are the goals and outcomes? How will it be done? Will it add something of value to existing knowledge in the field? The research proposal should be clear and should meet the requirements of the funding agency. It is important to look at what the funding agency says on its web page. What do they describe as their research priorities? One should try to approach the right funding agency for the grant.

First of all, draft specific aims and think about the research question. This is the most important thing. Is a pilot study necessary before actually forming the question? Then, develop a study design and methods, identify population and decide the methodology, i.e. how the project will be conducted? What is the kind of data needed? What will be required in terms of personnel and money? Develop a time line. It is important to have a realistic time line. Always discuss with a statistician because, far too often, difficulties may arise because the statistical design or sample size was not properly planned.

Different components of the proposal should be properly outlined as follows.

a. **The title** should be accurate and descriptive. It should preferably include the type of study like randomized clinical trial or a cluster randomized study or a cohort study, etc.

b. **The abstract** normally is about 300 words and it should include the research question, the rationale, the methods and the implications of the findings.

c. **The introduction** should create the reader's interest in the topic. It should lay a broad foundation for the problem that leads to the study. It should try and place the study within the larger context of the literature and reach out to a specific audience. Generally, the introduction section should end with a problem statement as to why to undertake this research.

d. **The literature review** should review the available knowledge but should also critically analyse and identify the gaps in the literature to formulate a hypothesis. Sometimes, what happens is the review of the literature lacks organization and structure, it lacks focus, it becomes repetitive, or it fails to cite the most important papers or recent developments. Failing to critically evaluate the papers which have been listed is a serious flaw. If there is preliminary data, it is generally a good idea to put it in because it shows that the investigator has an interest in this field and has the expertise as well.

e. **The aims and objectives** are usually scientific aims, but in some types of grants, one can also have social or political gains as aims, or capacity building as an aim. Generally, have an overall strategic aim followed by specific aims: primary and secondary. A research question poses a relationship between two or more variables but phrases the relationship as a question; a hypothesis represents a declarative statement of the relations between two or more variables.

f. **Methodology** is a very important section of the proposal as it describes the approaches and strategies to be undertaken to tackle a research problem. The time frame, workplan and

activities necessary for the completion of the project need to be fully described. It should contain sufficient information for the reader to determine whether the methodology is sound. It should demonstrate knowledge of the different or alternative research methods and make the case that the chosen approach is the most appropriate and valid way to address the research. The methods section generally describes approaches, strategies, time frame and so on. The design should state clearly like what is the kind of study, who are the subjects or participants, what are the instruments and procedures to be used, and what activities would be undertaken. If it is a randomized clinical trial, one needs to go into much more detail in terms of sample-size calculation, the randomization procedure, whether it is blinded or not, assessment of end point, the ethical issues, whether there are termination rules, and is there a data safety management committee, etc. And if it is a qualitative study, then there is a need to tell whether there will be focus group discussions or interviews. Provide interview guides and the sampling frames. What kind of analytical techniques are going to be used and which software will be used, because there are specific software for qualitative studies.

g. **Time line** or timetable (could be in the form of a Gantt chart) is very useful and shows that the practical aspects of undertaking the research have been carefully considered by the investigator.

h. **Limitations:** Mention weaknesses of the proposed research which may be justified by time and financial constraints as well as by the early development stage of the research area.

i. **Significance** of the study should be mentioned in a paragraph.

j. **The bibliography** and **appendices** or annexures are given which could include the original scales, questionnaires, informed consent forms, etc.

There are certain rules for writing for a grant. One is, get started well in time, establish a benchmark and see whether internal reviews and discussions are needed. Is it an electronic submission? Allow time for the feedback. Always submit on time. Read the instructions because every funding agency has its own format which it would like you to use for the application, otherwise the application will be rejected. Use appendices wisely, check websites frequently and, if necessary, make contact with the agency. Most funding agencies have a programme officer, or somebody to answer queries. So, if there are any doubts about the grant, you can always e-mail them or call them. Make it easy for the reviewers, so write from the reviewers' perspective, assume that they are not experts in that field, and in this, clarity is the key. Use sub-headings, tables and figures. Collaborate when possible. Assemble a team that, in addition to the biomedical person, has a social scientist. a statistician and a health economist if needed. It makes the proposal look much stronger. Meet with collaborators and get feedback and comments from colleagues before submission to the agency. Many of the web pages of funding institutions would have a lot of information and guidance for grant applicants, so look at these to know how to go about it and what format to use.

Some common mistakes in proposal writing are: failure to provide the proper context and research question (Box 3); failure to cite the previous work that has already been done and to accurately present contributions by others; and failure to stay focused on the research question. One must develop a coherent and persuasive argument for the proposed research. Too much detail on minor issues without enough detail on major issues, and too many citation lapses or incorrect references, and the proposal being too long or too short and sloppily written. Finally, do not give up, because one does not get funds the first time around. One should not get disappointed and give up; keep trying and ultimately you will succeed and learn as you go along.

Box 3: Common mistakes in proposal writing

- Failure to provide the proper context to frame the research question.
- Failure to cite landmark studies.
- Failure to accurately present the contributions by other researchers.
- Failure to stay focused on the research question.
- Failure to develop a coherent and persuasive argument for the proposed research.
- Too much detail on minor issues, but not enough detail on major issues.
- Too many citation lapses and incorrect references.
- Too long or too short.
- Sloppy writing.

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Epidemiological research and methodological issues

Jayaprakash Muliyil

Research is not a random collection of data and mindless computation but is about explaining how things work. Epidemiological studies are categorized into experimental and observational designs. According to Alber Van Szent-Gyorgyi, "Discovery consists of seeing what everybody has seen and thinking what nobody has thought." One needs to remember two points. As one comes down the hierarchy, the validity is supposed to go down; but as one goes up the hierarchy of designs, ethical problems keep increasing.

Most people do not pay adequate attention to paradoxical findings. A paradox is truth standing on its head to attract attention. When one finds something that is not ordinary or is not expected, one is on the verge of a new discovery.

David Hume, a Scottish philosopher, concluded that observational studies cannot provide proof regarding casual association. His argument was: if you light a matchstick and bring it close to your finger, you can see the lighted matchstick and can feel the pain, but that matchstick is causing the pain is made up in your mind. There is no logical basis for that conclusion. Here is a switch. You put it on and light comes on. You put it off and the light goes off. You do it a hundred times and every time you put it on the light comes on, every time you put it off the light goes off. Are you now absolutely certain that the switch causes the light to come on? How do you know that there is not another person sitting in the next room using another switch? Carl Popper agreed with Hume but also suggested a way out of the problem. Start with the hypothesis that the switch has nothing to do with the light. That is your new hypothesis. Now you should gather evidence. Switch it on and the light comes on, switch it off and the light goes off. After a certain number of tries you will have to conclude that you do not have evidence to support your hypothesis. So you have to reject it in favour of the opposite, i.e. the switch has something to do with the light. That is a very clever way of overcoming the problem. But it leads us to another peculiar problem. We have hypotheses which have been falsified and hypotheses which have not been falsified. Something remains as true only because you have not got the evidence to the contrary. Very tenuous position for a scientist but that is all we have.

What is the difference between fact and theory? When you have measured or observed, there is no denying that it is fact. Theory deals with the question: why is the fact so? For example, the sun rises in the east and sets in the west. There is no doubt, it is a fact. Then the next question is, why does it happen? The answer for many thousands of years was that the sun, the moon, and the stars are going around us. Earth is the centre of the whole universe. Later, this theory had to be changed. Earth is spinning on its own axis. In practice, medicine gathers lots of facts and some of these are supported by p values. But that is not the whole story. One needs to explain why these facts happen.

Many years ago I had a question. Does BCG protect against leprosy? About 15 000 schoolchildren were studied. Some of them had BCG scars and the remaining did not have BCG scars. They were followed up for three years. The incidence of leprosy was calculated among the vaccinated and the

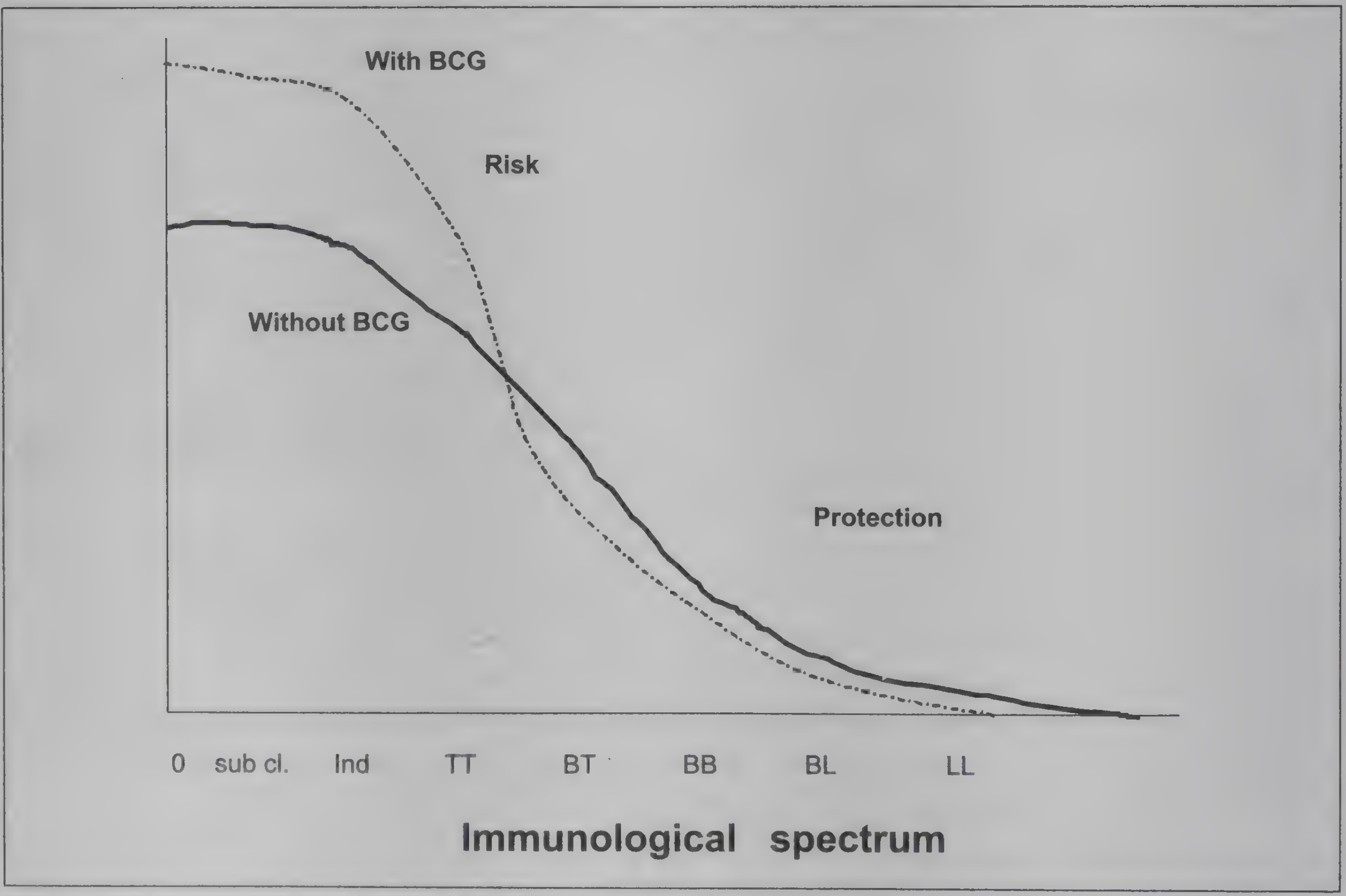
unvaccinated. The relative risk turned out to be 1.4 whereas the expectation was to get a relative risk of 0.5. So, here was a paradox standing on its head, trying to draw attention. Later, a large case-control study was carried out.

In the case-control study it was found that those who were vaccinated with BCG had 2.7 times greater chance of getting indeterminate leprosy (IL), but against Borderline borderline leprosy and borderline lepromatous leprosy (BBBL), it showed 75% protection (Table 1). Indeterminate Leprosy is a mild form of leprosy which is very often transient and self-healing. Tuberculoid Leprosy (TT) too is more or less a self-healing form of the disease. Borderline Tuberculoid leprosy (BT) is very often troublesome as it leads to deformities. Schoolchildren who were vaccinated got an accelerated response to *Mycobacterium leprae* infection and got mild forms of leprosy (Fig. 1). Higher risk of leprosy among schoolchildren was actually the demonstration of a protection against serious forms of leprosy. Instead of getting multi-bacilli leprosy at the age of 25 years, they were getting mild tuberculoid leprosy or indeterminate leprosy in the school-going age group. In a population exposed

Table 1: BCG and leprosy: a case-control study

Type	n	OR
Ind.	23 (41)	2.76
TT	291 (489)	0.78
BT	59 (85)	0.32
BB / BL	7 (10)	0.25

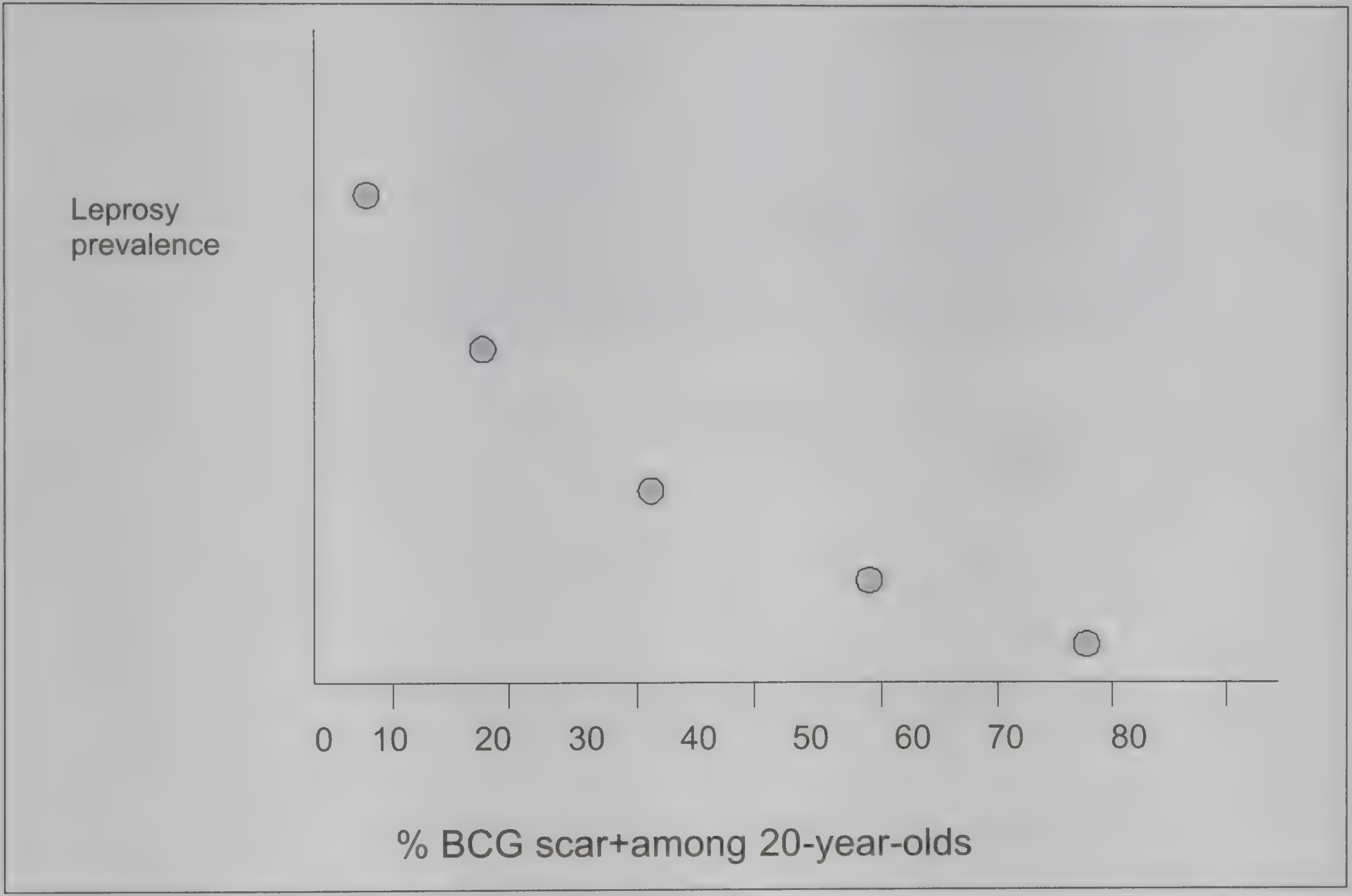
Fig. 1: Hypothesized effect of BCG on the immunological spectrum



to endemic leprosy, many develop subclinical and some develop more serious forms of the disease. The moment BCG vaccination is given, there is a shift in immunity to a more Th-1 type of response. What happens then is a more subclinical and more indeterminate type of leprosy among the vaccinated and that does not matter. The impact is in terms of a reduced incidence of serious forms of leprosy and consequent disabilities.

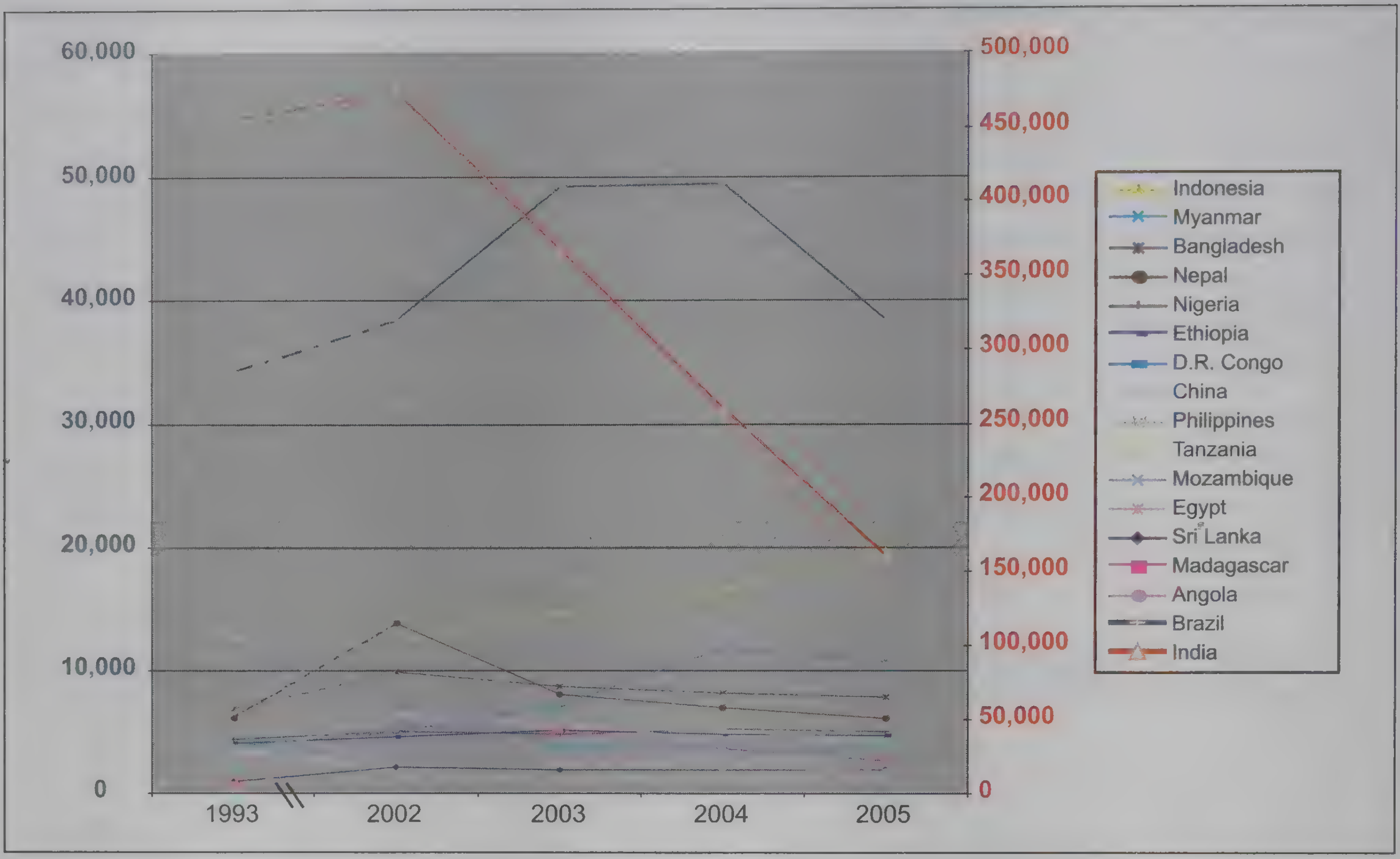
In an ecological study, it was realized that if the BCG vaccination rate is maintained for a long time, the leprosy incidence seems to fall. In 40 clusters of villages, the BCG scar rate was measured among the 20-year-olds (which was an indicator of BCG coverage 20 years ago) and current prevalence of leprosy. There was a significant negative correlation (Fig.2).

Fig. 2: Ecological evidence



By 2000, leprosy was supposed to have been eliminated from India. The elimination of leprosy means prevalence of one case per 10 000 population. India has over one billion people, and if there are less than 100 000 cases on the leprosy register, the disease would then be considered to have been eliminated. The aim was to eliminate leprosy by 31st December 2000. Did it happen? No, India did not achieve the target. Myanmar, Bangladesh and many other countries were able to eliminate leprosy. Then the target date for leprosy elimination was reset for 2005. What happened between 2000 and 2005? In the top 16 leprosy-prevalent countries in the world, there has hardly been any fall in the new case detection rate since 1993. In fact, some countries like Indonesia showed an increase. It is fascinating to note that during 2000-2005, new case detection has crashed in India (Fig. 3). This is a miracle. Should not there be research to find out how India succeeded in bringing down the incidence of new cases of leprosy so rapidly which no other country could achieve? One needs to explain why leprosy incidence declined in India.

Fig. 3: Trends in new case detection–top 17 countries



Source: http://www.who.int/entity/lep/situation/NCDetection2006.pdf

Scientific writing

Chairpersons: *Roger Detels*
K. Satyanarayana

Session Coordinator: *Renu Garg*

Successful scientific writing – *Roger Detels*

Responding to editorial decisions – *Colvin Gunaratna*

Increasing your chance of getting published – *Hooman Momen*

Successful scientific writing

Roger Detels

Sharing the results of research depends on their publication. However, publication requires the ability to write a sound research paper. It is said that "If you don't publish you didn't do the research." In this brief paper, key factors for achieving success in scientific writing are outlined.

The key to success in publishing research depends on the clarity, precision and conciseness of the communication. The author needs to keep in mind that the objective of scientific writing is to convey information, not to impress. Clarity requires the use of short, simple sentences, with few sub-phrases and clauses. A paper needs to say what needs to be said and no more. The author should not bore the reader with extraneous information that obscures the main message of the paper. On the other hand, the paper needs to provide enough information, particularly about the methodology used, to allow the reader to correctly interpret the results and judge the quality of the paper. The author needs to avoid ambiguity as it will obscure the message of the paper and confuse the reader. *Do not* say more than what the data will support, but *do* say what the data *will* support. Use a language that conveys the correct interpretation of the results of the study.

The first step in constructing a research paper is to define the message that the author wishes the paper to deliver. However, be aware that the message may change as you write the paper and analyse the data in depth, allowing greater insight into what had been done.

For new writers, the greatest barrier is often writing the first draft. The author should not invest his/her ego in the first draft. Do not strive for perfection in the first draft; just try to get all the information into it. There will be lots of opportunities to make revisions, corrections and additions in later versions of the draft. Do get your friends (and enemies) read the draft. One may think that the message has been delivered, but they can tell if the paper has been effective in delivering that message. They will often also identify issues that were neglected and which need to be included.

Bradford Hill has suggested that a paper should answer the following questions: Why the study was started (introduction)? What did the study do (what methods were used)? What did the study find (what were the results)? and, What do the results mean (discussion, interpretation, conclusion)?

The usual format of a scientific paper is introduction, methods, results and discussion. The introduction presents the rationale for doing the study. The presentation of the rationale requires a brief review of the relevant background and level of knowledge available regarding the topic being presented. The introduction should begin with the general and focus down on the topic of the research being reported in the paper as the next logical step in the progression of information and knowledge on the topic. It should conclude with a statement of the objectives of the study.

The quality of the paper will be judged on the appropriateness and relevance of the methods that were used. Therefore, it is important to be sure that all the relevant methods are presented. The author needs to provide enough details for the reader to evaluate the quality of the study. In epidemiological

studies, it is important to provide a description of the referenced population for which the study results will be utilized and how the individuals included in the study were selected. It is especially important to provide details of the strategies that were used to analyse the results of the study.

In presenting the results of the study it is important to be precise and to use simple and direct language. Use tables and figures that will enhance the understanding of the results. Avoid complex tables and figures that will hinder comprehension. Remember that the results must be clear and unambiguous if the message is to be delivered successfully. It is important while presenting the results to include estimates of variability (e.g. confidence limits and/or probability values).

The discussion section provides the opportunity to interpret the results and to indicate what new information they present as well as placing them in the context of the field. It is important, however, not to interpret beyond what the data can defend. Thus, statements need to be backed up by making reference to the relevant data in the results section. Do not go beyond what the methods will support. In this context, it is important to clearly identify what the limitations of the data are and how they affect the interpretation of the results. Discuss the implications of the study for formulation or modification of policy if relevant. Finally, it is important to discuss the implications of the findings and what the next steps in elucidating the topic should be in the light of the study.

Writing a research paper can be enjoyable and it often leads to a better understanding of what has been done and what it all means.

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Responding to editorial decisions

Colvin Goonaratna

The most prestigious and second-tier journals receive far more papers than they can publish. Hence, the rejection rate for the first category will be somewhere between 70% and 90%, and for the second, between 40% and 70%. The results of research that do not achieve publication are of limited importance. Two famous epigrams – "Work, finish, publish" (Faraday), and "The object of science is publication" (Ziman) – epitomize the decisive role of publication in the advancement of science as well as researchers' careers. So, it behoves all authors of research papers to perfect as a core skill the art and craft of responding prudently to editorial decisions if they wish to boost the chances of their papers being accepted for publication

Operating processes used in selection of papers for publication

There is a wide variation in the processes that journal editors employ to decide which papers to accept and which to reject. Generally, the chief editor or a couple of associate editors will browse through all the papers received as an initial screening procedure. Some papers will be rejected at this stage because they are considered irredeemable. The remainder will be sent along diverse paths that are determined by the journal's editorial policies.

Some journals prefer an in-house review system where the papers are reviewed by assistant editors and editorial board members. Most of the prestigious journals' editors enjoy the benefit of having comprehensive lists of external reviewers whose services can be used for practically any kind of paper the journal may receive.

Several journals now receive, process papers, and communicate with authors as well as manuscript reviewers entirely online. Some editors request authors to propose, as a matter of journal policy, the names of two or three reviewers of their choice, of whom the editor may choose one. Some editors prefer external review by manuscript consultants whose identity will remain unknown to authors, whereas others may permit an online dialogue between author and reviewer, moderated by the editor or a designated assistant editor.

It is important for authors to remember that, although widely different operating procedures may be employed by journals in selection, it is the editor who will communicate the decision and take ultimate responsibility for it, and it is with him (or her) that the author must communicate.

Criteria applied in selecting papers for publication

Most editors apply at least three of the five criteria given below in choosing papers for publication.

- Trueness, i.e. validity of methodology, evidence supporting the paper's conclusions and interpretation of results.

- Newness, i.e. originality of the paper's message.
- Importance of the paper's message to the scientific community or the management of public health.
- Relevance to the journal's scope and audience.
- Quality of presentation of the manuscript.

Editors are unlikely to have the label "tardy" fixed onto their journals for delaying decisions regarding papers. Four to six weeks would be a fair delay for a paper reviewed by an in-house assistant editor, and six to eight weeks for one reviewed by an external manuscript consultant. Sending a polite inquiry to the editor after eight weeks to ascertain the status of the paper would be reasonable.

The editor's decision about publication

Read the editor's decision carefully. Has the paper been accepted without any reservation, with minor revision, or with major revision? Has it been rejected outright? Has the editor advised submission after revision for reassessment or reconsideration?

Editorial instruction to revise will usually be accompanied by the reviewer's comments in full, or with relevant extracts of it. Critical comments that may appear rude, unfair or invalid at first might be manageable with the passage of time and calmer contemplation. So, putting the review away for a few days is not a bad idea. Discussing the reviewer's comments with co-authors or a more experienced colleague also helps in planning your response to the editor's decision.

Few papers receive immediate and unconditional acceptance, or acceptance with only minor revision. Even papers that are immediately accepted for important and valid content may need to be revised; for example, rearranging tables and illustrations, shortening text, deleting unacceptable abbreviations, or rephrasing an ambiguous sentence. If the paper has received acceptance with such requests for revision, response must be to accept the decision promptly, but without needless genuflection, for it has been accepted on its merits and not because the editor wants to do you a favour. It would be silly now to quibble about minor revisions unless there are very sound reasons for disagreeing.

All authors have had their papers rejected at least once in their lifetime. Some of the world's most famous and ground-breaking papers (e.g. Kreb's Cycle) were rejected several times before being finally accepted by a reviewer and an editor with vision. Nowadays, there are many thousands of journals so that almost all initially rejected papers get eventually published somewhere.

These prefatory remarks ought to soothe the wrath and despair of authors whose papers have been rejected, most unfairly of course in their view. If the paper has been rejected outright there are four options to consider: (1) abandon the paper; (2) submit to another journal without revision; (3) submit to another journal after revision; and (4) protest or appeal the decision.

Abandoning the paper at this threshold stage is most unwise unless one is quite convinced that the paper is hopeless; but that ought to be an extremely rare circumstance.

Sending the paper to another journal without revising it has its advocates, and advantages. The main arguments in favour of this course of action are, firstly, that the review process is flawed because it is subjective, often biased and coloured by personal preferences; and secondly, that spending time on revision based on such reviews (with which you obviously do not agree!) is a waste of time. About 40% of the authors send their rejected paper to another journal without revising.

Most authors who have experienced rejection agree that although the review process is often blemished, using the reviewer's comments to revise a paper before a second or third submission improves it and its chances of acceptance. The trick is to focus on the editor's summing up (when

available) of reviewer's comments and only those critiques of reviewers with which you agree, and not to expend too much time revising.

While sending the paper to a second or third journal, ensure that the manuscript bears no marks of its previous submissions (e.g. old stapling punctures). The latest manuscript should conform to all the technical requirements of the intended new journal (e.g. style of arranging the title page, citation of references in the text, etc.) so that the editor has no reason to doubt that he/she is the first editor to see it.

If the paper has been rejected three or four times or more, it would be reasonable to consider abandoning it, particularly if successive reviewers tend to agree that the methodology has serious imperfections, or the findings are stale old hat.

If the paper has been rejected, should one protest or appeal the editor's decision? A lot depends on the exact wording of the decision. If the wording goes like, "Your paper is outside the scope of our journal", or, "Your paper could not be given high enough priority for publication", then there is no point in protesting or appealing, because the editor is telling you that the paper's message is not new or important enough for the journal. Accept the decision and look elsewhere for publication.

If the editor's communication makes recommendations for revising the paper, the crucial question to ask is whether he/she agrees to publish it once the revisions have been made. Equivocal statements, such as, "We are willing to reconsider your paper", are not good enough. Ask the editor by a polite letter for an unequivocal decision, and if that is not forthcoming, the wiser course would be to make the revisions and submit to a journal of second choice even if that is less prestigious than the first.

Should one protest or appeal the editorial decision of rejecting the paper? Even if, after sober and objective cogitation over several days, one thinks that the reviewers have been biased, unfair and cruel, protesting the decision has very low returns. Why waste valuable time writing a protest letter to someone who has already rejected the paper when it can be sent to a second journal much sooner by revising it judiciously?

Appealing the editor's decision or asking for a different reviewer are only rarely successful; the success rate is about 12% for the most dispassionate appeals based on evidence (not rhetoric) and crafted in the best traditions and diction of advocacy. The chances of publication are much brighter if one moves to another journal. The object of research is publication, remember?

Increasing your chances of getting published

Hooman Momen

Getting your paper published in a prestigious journal is now more competitive than ever before. To deal with this topic I will be using the *Bulletin of the World Health Organization* (WHO's journal of international public health) as an example and give advice on how to increase your chances, under the following nine headings:

1. **Is your paper within the scope of the journal?**
   a. Read a couple of issues of the *Bulletin*.
   b. Do you think your paper is similar to something we have already published? If so, send it in.
   c. If not, you may wish to try another journal.

2. **What sort of papers do we want?**
   a. The *Bulletin* publishes papers on matters of international public health.
      – This is a very broad field, and we consider a very wide range of papers.
   b. The papers that survive peer review and are accepted for publication have some common features.
      – The work described has some implications beyond where it was done.
      – We learn something from the paper.
      – We think that our readers would learn something, or find the contents useful to them in their work.
      – The work is novel, relevant and valid, and has been conducted in an ethical manner.

3. **What kind of paper have you written?**
   a. Is it research? (Does it have a hypothesis, clear methods, testing, results and discussion?)
   b. Is it policy and practice? (Is it a non-systematic review, debate or hypothesis-generating piece?)
   c. Is it a perspective or round-table base paper? (A short paper presenting a view, hypothesis or discussion of a topic of public health interest?)

4. **Top 10 reasons for rejecting a manuscript**
   a. Content of the paper not suitable for an international journal of public health.
   b. Design of the study not appropriate for the question asked.
   c. Lack of novelty and/or timeliness.

d. Lack of either or both ethical committee approval and informed consent.
e. Lack of an appropriate search strategy.
f. Conclusions not justified by the results.
g. Lack of a feedback step in descriptions of audit.
h. Insufficient sample size.
i. Lack of a clear message to the public health community.
j. Secondary analysis of demographic surveys or simple prevalence studies that are difficult to generalize.

5. **What to do with your paper before submitting?**
   a. Make sure you have clarified authorship.
   b. Authorship credit should be based only on substantial contributions to 1) conception and design, or acquisition of data, or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; and 3) final approval of the version to be published. Conditions 1, 2, and 3 must all be met. – ICMJE (Vancouver) Guidelines.
   c. Collect all the authors' statements of competing interests.

6. **The *Bulletin's* policy on competing interests**
   a. Competing interests arise when authors have personal, commercial, political, academic or financial interests that are not fully apparent.
   b. The *Bulletin* requires authors to disclose their competing interests upon submission or review of a paper for any section of the journal.
   c. Authors' competing interests statements will be taken into consideration when a final decision is made to accept or reject a paper.
   d. The *Bulletin* requires that authors explicitly state all sources of funding for the research or writing activities.

7. **How to submit?**
   a. Decide on the section of the *Bulletin* to which you wish to submit the paper.
   b. Check that you have followed our 'Guidelines for Authors' for that particular section.
   c. Go to http://submit.bwho.org
   d. Follow the instructions for online submission provided at: How to submit your manuscript.

8. **Replying to decision letters**
   a. Read letter from Editor and attached reviews carefully.
      - Stay calm.
      - Constructive criticism is by far the greatest service that an author can receive from a journal.
   b. Write a detailed letter explaining for every point raised:
      - What modifications you have made in response to criticisms you have accepted.
      - Rebuttal of any reviewer's criticisms that you disagree with.
   c. Resubmit a revised manuscript incorporating all the amendments.

9. Appealing editorial decisions

a. The *Bulletin* recognizes authors' rights to appeal editorial decisions.

b. Authors who wish to submit appeals of manuscripts that have been rejected
   - should first consult list of reasons for rejection to make sure that they have a good case for making an appeal.

c. Write a detailed letter explaining why manuscript should be reconsidered
   - and provide a point-by-point rebuttal of any reviewer's criticisms.

d. Your appeal is upheld,
   - your paper is back in the workflow for consideration.

e. Your appeal is rejected,
   - editor concerned will write you a letter explaining the reasons for this decision.

f. One appeal per paper
   - increase your chances by supplying as much detail as possible in your request.

Section 6

Closing ceremony

Valedictory address

Nirmal K. Ganguly

One of the major challenges in the last 40 years has been to make the primary health care system function optimally. It has gone through several incarnations but it still needs further revitalization. Another very vexatious problem has been the lack of access to public health data. Many good things have happened when such access was provided. When secondary analysis of HIV data was allowed, it gave an insight that the HIV incidence was really coming down in India. One major thing which is really needed is how to share data among all countries in the South-East Asia Region of WHO even before its publication so that they can learn from each other's experience.

How to use epidemiology for community-based action is another area. This is a practical aspect as communities do not easily understand epidemiology. A simple language needs to be created which will reach the community. How access can be improved to ensure equity and how evidence collection can help in improving the health of the poor are very challenging issues. The management issue is one of the weakest elements of the public health system. There are centres which teach management and there are centres which teach public health, but rarely do they get together. Stewardship is something which is very new. How to create networking through the Internet is another issue. Bringing together people in meetings has become very costly; hence, it is important to explore how to use video conferencing. Also, more use should be made of mobile telephony to track diseases, track treatments and track access to drugs, diagnostics, etc. These are powerful tools which are now available and which should be used more often.

The Millennium Development Goals (MDGs) are very challenging. If political leaderships looked for what is happening around them, it will shock them to learn about the roadblocks that are preventing the realization of MDGs. The National Rural Health Mission in India has been overburdened with managing nutrition, immunization and mothers' health and looking at malaria, filaria and many more health areas, thereby diluting its impact. The MDG goals set for 2015 should not be like other declarations which have not happened. It will be a sad day if MDGs were not realized. How to manage performance? How to manage programmes? A true analysis will open the eyes of all those who have interest in public health.

The example of H1N1 shows how it empowered developing countries by putting in place state-of-the-art surveillance networks using most modern tools. Good laboratories have emerged in some countries in the South-East Asia Region, e.g. India, Indonesia and Thailand, to collect good data. Sequencing facilities have also come up. The whole human genome will be available at a very low cost by 2015. These are the new developments in technology. However, technology and public health were alien to each other before, but now technology and public health must come together. The Geographic Information System (GIS) can be used to facilitate this. The new innovations are very vibrant. Analytical and modelling skills need to be honed. Without epidemiological analysis and modelling, many issues will never be resolved.

Closing remarks

Salim Habayeb

The guiding principle that motivates policy is indeed evidence, which is essential for decision-making. Epidemiology can guide the whole cycle of work, i.e. building on recommendations generated by evidence, and, then, responding to emerging challenges in the health sector and beyond. Attempts have been made to build strength in many areas of epidemiology. Through extensive technical collaboration, training and fellowship programmes, networking with collaborating centres and centres of excellence nationally and internationally, as well as through direct and indirect support to national and regional efforts, capacity would be increased in various areas of epidemiology.

But apart from capacity building in epidemiology, there should be involvement in other substantive areas. First, there is a historic and arbitrary separation of health planning from health sector planning. With rising health care costs, discussions need to move to funding. Clinical practice and health care planning have increasingly become permanent subjects of epidemiological research, but the role of epidemiology in planning is not yet fully established in public health. Yet, this is where the interest is growing and research funding is increasing.

Challenges are encountered in the application of epidemiology. Evidence-based guidelines have improved clinical outcomes, but effective therapies are not fully applied. Ineffective, costly and unnecessary treatments continue to be prescribed at individual level and in public health programmes. Finally, frustrating delays are witnessed between acquiring epidemiological evidence and its application in health policy. Clearly, these challenges need to be addressed so as to make optimal use of epidemiology for guiding the way forward.

Vote of thanks

Shiv Lal

As we come to the end of the conference, we have now a set of conclusions and recommendations which have come through discussion on all aspects of epidemiology. Participants have also adopted the Delhi Declaration. All the countries of the South-East Asia region have significantly contributed to this declaration. This needs to be implemented in a meaningful way and in a time bound manner.

On behalf of the organizing committee I would like to express our gratitude to the Hon'ble Minister of State Govt. of India Shri Dinesh Trivedi and Ms Sujatha Rao, the Union Health Secretary, Government of India, who could not attend the valedictory session because of their urgent commitment. Our thanks are due to Dr. Samlee Plianbangchang, Regional Director, WHO for his inspiring leadership, guidance and continued support in organization of this conference. I thank Prof. N. K. Ganguly for his guidance and support and for kindly agreeing to grace this occasion. Special thanks to Dr. Jai P. Narain and his team for their hard work, leadership and guidance from time to time. We deeply appreciate distinguished speakers, chairpersons and delegates guests, media and foot soldiers of the organizing committee for making this conference a big success. Generous contribution and commitment of the partners and cosponsors are deeply appreciated. We hope that more partners will join this journey. Once again I thank one and all for their contribution. I would like to put on record our deep appreciation to organizing committee of this conference.

Annexes

Annex 1. Programme

Monday, 8 March 2010

0800 Hrs	**Registration**
0930 – 1015 Hrs	**Opening Ceremony**
	Welcome by Dr Shiv Lal, Conference Chair
	Conference objectives by Dr Jai P NARAIN, Conference Co-chair
	Address by Dr Samlee PLIANBANGCHANG, Regional Director, WHO/SEARO
	Address by Mr Kapil SIBAL, Hon'ble Minister for Human Resource Development, Govt of India
	Address by Mr Ghulam Nabi AZAD, Hon'ble Minister of Health and Family Welfare, Government of India
	Vote of thanks by Dr C S PANDAV
1030 – 1200 Hrs	**Plenary**
	The enduring relevance of epidemiology Co-chairs: R K SRIVASTAVA and Ron WALDMAN
	Speakers:
	Epidemiology in action: past, present and future David HEYMANN
	Revitalizing primary health care: how epidemiology can help Ravi NARAYAN
1200 – 1300 Hrs	**Lecture:** Power of free access to public health data for exploration, monitoring and advocacy Hans ROSLING,
	Introduction by: Mariam CLAESON

1400 – 1530 Hrs **Parallel Sessions**

Epidemiology and public health emergencies: the critical need for preparedness and response
Chairpersons: Poonam SINGH and Mahmudur RAHMAN

Speakers:
Facilitating appropriate response in disasters: the role of epidemiology
Giuseppe ANNUNZIATA

Laboratories as essential component in public health emergencies
A C MISHRA

Risk communication: a challenge for epidemiologists
Supamit CHUNSUTTIWAT

Non-communicable diseases, risk factors and epidemiology
Chairpersons: K Srinath REDDY and Jerzy LEOWSKI

Speakers:
From research to policy: example from NCD surveillance
Bela SHAH

Epidemiology and reducing burden of cardiovascular diseases in Asia
Shah EBRAHIM

Research and evidence building for advocacy
Rajesh KUMAR

Skill-building session: Research methods
Facilitators: Roger DETELS and Sujit BHATTACHARYA

Speakers:

Health Research: concepts, methods and techniques
Raina MACINTYRE

Research proposal writing
Soumya SWAMINATHAN

Epidemiological research methodology
J P MULIYIL

1600 – 1730 Hrs **Parallel Sessions**

Panel Discussion: Re-focusing on forgotten priorities: Acute diarrhoea and pnuemonia
Chairpersons: N K ARORA and Richard CASH

Panelists:

Rotavirus and control of acute diarrhea in Indonesia
Yati SOENARTO

The burden of Pneumonia in the South-East Asia Region.
Shams El ARIFEEN

Integrating prevention and control of acute diarrhoea and respiratory infections in the South-East Asia Region of WHO: a new initiative.
Madhu GHIMIRE

Disease epidemiology, modeling and innovation
Chairpersons: N K SETHI and Laurette DUBE

Speakers:

A brain-to-society approach to chronic disease prevention and epidemiology
Laurette DUBE

Using GIS technology in chronic disease epidemiology
Mark DANIEL

Agent-based computational modeling in epidemiology
Ross HAMMOND

Social Innovation and Civic Participation: a new shape of the development in India
R C MISHRA

Skill Building workshop: Scientific writing
Facilitators: Roger DETELS and K SATYANARAYANA

Speakers:
Key elements of successful writing
Roger DETELS/Peush SAHNI

Responding to editorial decisions
Colvin GUNARATNA

Increasing your chances of getting published
Hooman MOMEN

Tuesday, 9 March 2010

0900 – 1030 Hrs	**Plenary**
	Epidemiology: ensuring health security Chairpersons: Shiv LAL and N Kumara RAI
	Speakers:
	Pandemic (H1N1) influenza: an overview and lessons learnt Keiji FUKUDA
	Emerging and re-emerging vector-borne diseases in Asia Duane GUBLER
	Climate change and role of epidemiology Jacob KUMARESAN
1045 -1130 Hrs	**Lecture:** Economic crisis and health of the poor: how evidence could help Jacques JEUGMANS
	Introduction: Tee Ah SIAN
1130 -1300 Hrs	**Plenary**
	Research to policy: walking on a bumpy road Chairpersons: V M KATOCH and Sangay THINLEY
	Speakers Translating data to information for policy formulation and implementation Hitoshi OSHITANI
	Research and policy interface Ulysses PANISETT
	Epidemiology: a tool for community action Abhay BANG
1400 – 1530 Hrs	**Parallel Sessions**
	HIV, TB and Malaria: framing policies and programmes in the science of epidemiology Chairpersons: Swarup SARKAR and Nani NAIR
	Speakers: Trends in Tuberculosis – What is the evidence? Knut LONNROTH
	Anti-malarial drug resistance: A potential global emergency Charles DELACOLLETE
	Towards universal access to HIV prevention and care Charlie GILKS

Panel discussion: Climate change: assessing vulnerability and defining adaptation strategies
Chairpersons: Sattar YOOSUF and Jacob KUMARESAN

Panelists:
Climate change in the SEA Region: mitigation & adaptation Strategies Post-Copenhagen
Leena SRIVASTAVA

Climate change and it's impact on diarrhoeal diseases, particularly cholera
G B NAIR

Climate change and the vector-borne diseases: experience from Indonesia
Supratman SUKAWATI

Climate change and Research
Gajananda Prakash BHANDARI

Symposium: Pandemic (H1N1) Influenza: update in the Region
Chairpersons: Keiji FUKUDA and Tee Ah SIAN

Panelists:
The role of influenza surveillance systems in the H1N1 response, Bangladesh
Mahmudur RAHMAN

India's response to H1N1
Shashi KHARE

Preparing Indonesia for the Influenza Pandemic
N Kumara RAI

Thailand's response to H1N1
Supamit CHUNSUTTIVAT

What activities should countries focus on now?
Keiji FUKUDA

1600 – 1730 Hrs **Parallel Sessions**

FETP and other applied epidemiology training programmes
Chairpersons: Raina MACINTYRE and V KUMARASWAMI

Panelists:
A ten year review of FETP in India
Dr Manoj MURHEKAR, Dr Akshay DHARIWAL

Expanding and utilizing FETP in Thailand
Kumnuan UNGCHUSAK

Management Information for Action for TB control: a short training course for programme officers
Nani NAIR

Establishing the Evidence - Informed Policy Network (EVIPNet)
Chairpersons: Ulysses PANISSET and Dorji WANGCHUK

Speakers
EVIPNet: The concept and the modus operandi
Ulysses PANISSET

Impact of research programme consortium on health policy
Prof Paul GARNER

EVIPNet in WPRO and Lessons Learnt
Gao JUN

EVIPNet in the SEA region: possible options
Prathap THARYAN

Leadership, management and epidemiology (symposium)
Chair: SD GUPTA and AS ABDULLAH

Speakers:
Leadership and management: key for health action
Jay SATIA

Management modules in epidemiology training to strengthen health system
Yvan HUTIN

Leadership and management training course
Saroj JHA

Impact of epidemiological skills on leadership
Tee Ah SIAN

Wednesday, 10 March 2010

0900 – 1030 Hrs	**Plenary**
	MDGs and epidemiology Co-chair: Jigmi SINGAY and Bjorn MELGAARD
	Speakers Monitoring progress towards the achievement of health-related MDGs: Are we in line with principles of epidemiology Myint HTWE
	Social determinants, MDGs and Epidemiology: understanding and addressing health inequities Than SEIN
	MDG 4 and 5: the challenge of reaching the elusive target Vinod PAUL
1045 -1130 Hrs	**Lecture:** Using epidemiological data for monitoring and evaluating programme performance James CHIN
	Introduction by: Lalit NATH
1130 -1300 Hrs	**Plenary:**
	Epidemiology for the future: challenges and opportunities Chairpersons: Ann Marie KIMBALL and N K GANGULY
	Speakers Methods and application of molecular epidemiology and modeling in disease control Masato TOSHIRO
	Application of GIS in monitoring drug resistance Pratap SINGHASIVANON
	Future of Epidemiology: how is our science changing? Ann Marie KIMBALL
	Towards universal childhood immunization: Why we must do and how we might? Stanley MUSIC

1400 - 1600 Hrs	**Plenary**
	Panel Discussion: Human resources for epidemiological and capacity building Chairpersons: Ranjit Roy CHAUDHURY and Palitha ABEYKOON
	Panelists
	Human Resources for health research and capacity building – Experience from hailand Virasakdi CHONGSUVIVATWONG
	Human Resources for epidemiology and capacity building – Role of medical schools C S PANDAV
	Epidemiology capacity needs of Bhutan Dorji WANGCHUK
	Epidemiological resources in the United States and their contributions to nation's health Scot DOWELL
1630 Hrs	**Valedictory Session**
	Rapporteurs' reports – Rajesh KUMAR, Rattan ICHHPUJANI and Rajesh BHATIA
	Delhi Declaration on Epidemiology
	Remarks by Dr Salim HABAYEB, WHO Representative to India
	Address by Dr VM KATOCH, Secretary, Department of Health Research
	Address by Ms Sujatha RAO, Secretary (Health), Government of India (TBC)
	Address by Mr Dinesh TRIVEDI, Hon'ble Minister of State for Health and Family Welfare, Govt. of India
	Vote of thanks

Annex 2. List of invited participants

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"Epidemiology is about the interplay and the interactions between human hosts, disease agents and their environments. It serves as a rationally logical foundation for public health and preventive medicine.

Through the application of epidemiological principles, health systems are provided with evidence-based knowledge, the most important tool for their functioning. Knowledge about the distribution and extent of health problems and health issues enables them to be tackled through public health interventions. Together with the information on health risks and health determinants, this knowledge will lead to the development and implementation of rational policies and strategies for the provision of effective, promotive and preventive health care to the community.

Evidence-based information can certainly help effectively in advocacy and education for health at all levels, in all populations. This information is also extremely important for education and training of all categories of health workforce."

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